

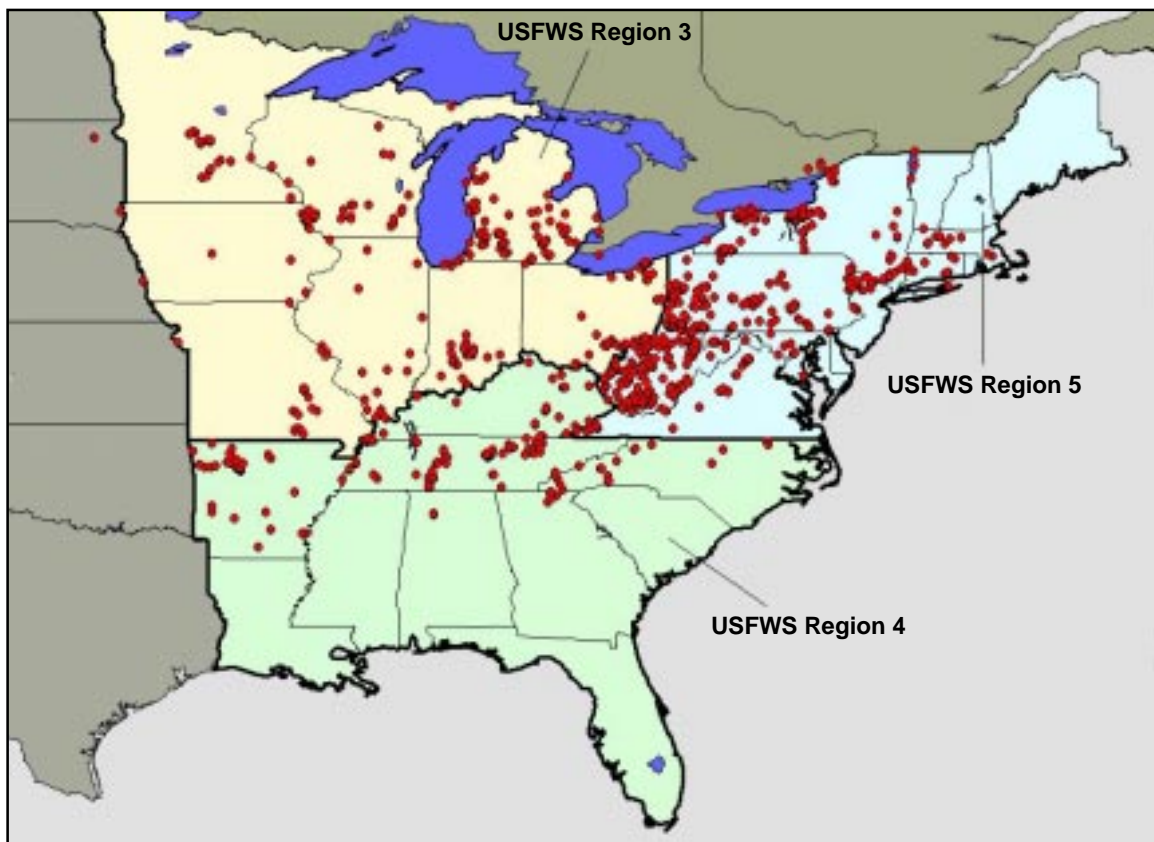
AN ATLAS OF CERULEAN WARBLER POPULATIONS

Final Report to USFWS: 1997–2000 Breeding Seasons

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CEWAP populations throughout the Cerulean Warbler's range, 1997–2000



Map 1. *Cerulean Warbler populations, as documented by CEWAP, in USFWS regions 3, 4, and 5.*

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INTRODUCTION

The Cerulean Warbler Atlas Project (CEWAP) was a four-year study designed to determine the population status, habitat, and area requirements of Cerulean Warblers (*Dendroica cerulea*), a high-priority Neotropical migratory bird, within USFWS Regions 3, 4, and 5. This study employed volunteer birders as well as professional biologists, and was administered through the Partners in Flight (PIF) regional and state working groups, USFWS contacts, and the Cornell Lab of Ornithology's network of citizen-scientists. This CEWAP Final Report summarizes and reports data submitted by each participating state and region from the 1997 to 2000 breeding seasons.

Need For Project

The Cerulean Warbler is among the highest priority landbirds for conservation in the United States. It ranks as extremely high priority on the national Watchlist based on Partners in Flight prioritization scores, and it ranks second in terms of immediate conservation concern in the PIF Northeast region (Rosenberg and Wells 1995, 2000). These priority rankings are based on a small total population size and a significant declining Breeding Bird Survey (BBS) trend throughout its range (-4.2% per year since 1966). Cerulean Warblers are declining across much of their North American breeding range and are now listed as a species of concern in 13 states, threatened in 2 states, and endangered in 1 state. They are also federally listed as "vulnerable" in Canada. In portions of the Northeast, however, Cerulean Warblers are thought to be expanding their range and population size. In the Midwest and Southeast—as well as areas in the Northeast such as New England, New York and New Jersey—this species is not adequately sampled by the BBS because of low overall density. Therefore, its distribution in these areas remains poorly known and accurate population trends have not been estimated.

Because of severe declines throughout the Cerulean's range, the USFWS has recently completed a Status Assessment of Cerulean Warblers (Hamel 2000), for possible listing under the Endangered Species Act. Hamel (2000) provides a compilation of historical records and contemporary anecdotes about the status of this bird; however, the report is limited by the lack of recent published information on this species from most states. In particular, conservation planning for regional populations is hampered by poor knowledge of present-day breeding locations, as well as by a lack of local data regarding habitat affinities, area requirements, or threats. In October 2000, a petition was filed to list the Cerulean Warbler as federally threatened. In light of the

Status Assessment and the petition, updated data concerning the Cerulean's status, population numbers, and critical breeding sites are of utmost importance. CEWAP attempted to fill these knowledge gaps by coordinating the efforts of professional biologists and experienced birders through a simple protocol designed to survey and study Cerulean Warblers throughout each region.

Project Goals

The original goals of CEWAP, as stated in the Scope of Work to the USFWS, were as follows:

- Identify important populations of Cerulean Warblers in each state, and determine the status of these populations—how many pairs? Are they reproducing successfully? Are there local threats to the population? Are populations expanding or declining?
- Determine the range of acceptable habitats and area requirements in each region—measure habitat structure, landscape characteristics of sites, nest-site characteristics, estimate densities in different forest-types, attempt to estimate productivity.
- Identify suites of bird and plant species associated with Cerulean Warblers
- Set population and habitat goals for the Northeast region and sub-region units, as part of the regional PIF planning process
- Produce a "how-to" manual of habitat management strategies for areas having (or potentially supporting) Cerulean Warblers

This atlas of Cerulean Warbler populations addresses the first portion of these ambitious goals. In this report we identify specific locations of present-day breeding populations in each region and state and attempt to estimate population sizes based on data collected by over 200 field collaborators. We also provide summaries of the habitat types and dominant tree species present at sites occupied by breeding Cerulean Warblers. Additional analyses of CEWAP data using GIS may elucidate patterns of habitat use at the landscape and regional scales. The results of this atlas will be incorporated into PIF landbird conservation plans; in particular, lists of specific sites for management or acquisition, as well as local data on habitats used, will aid in setting regional population objectives for this species. Our intention is to publish a completed version of this atlas, along with the most up-to-date summary of conservation and management guidelines, based on CEWAP and other information.

METHODS

CEWAP took advantage of the expertise of active birders and professional biologists by employing networks of volunteers. The Lab of Ornithology hired field assistants in 1997, 1998, and 1999 to cover areas thought to be potentially important breeding areas for ceruleans. These specific areas within states were systematically searched; however, coverage of entire states was often still incomplete.

Field protocols consisted primarily of surveying known sites (determined through state atlas workers, other birders, and published literature) to determine numbers of pairs, breeding status of population, and conservation status of site. In addition, participants surveyed as many new or potential sites as possible, to identify new breeding sites and determine status (as in the first project goal). At a small subset of sites with large or important populations, additional data on nesting and foraging, as well as productivity and threats to populations, was available through collaborating researchers.

Because of our reliance on volunteers and unsupervised field assistants, and the large differences in terrain and habitats surveyed, there was much variation in actual survey methods employed in the field. A majority of data came from variations on the “area-search” method, where observers moved through potential habitats noting presence and numbers of singing male Cerulean Warblers. Variations ranged from systematic surveys along all navigable waterways by canoe in the Montezuma Wetlands Complex of NY (Bill Evans), to driving slowly along rural roads in northern NJ (John Benzinger), to hiking the Appalachian Trail in Virginia and North Carolina, to floating stretches of several rivers in Missouri, to systematically driving and hiking through forested regions and conducting point counts wherever ceruleans were detected (David Buehler), to spot-checking isolated woodlots. Field surveys often used recorded Cerulean Warbler vocalizations (as needed) to elicit responses from territorial males, approximate territorial boundaries (especially in linear habitats), and determine pairing status (females often respond to tapes within their territories). After visits to a site were completed, observers were asked to attempt an estimate of the total breeding population of Cerulean Warblers at that site.

In addition to these CEWAP surveys, we received several datasets with point-count locations for Cerulean Warblers, often detected during more general bird surveys. In these cases, it is often impossible to know how much available habitat was covered or what proportion of a regional population of Cerulean Warblers was sampled—these are retained in our Atlas as minimum estimates for these areas. In a few states we relied on

additional surveys conducted prior to CEWAP or as part of independent research efforts. Finally, some holes in our Atlas were filled by gleaning miscellaneous records from birding e-mail lists, recently published Breeding Bird Atlases, or by hounding certain birders and state biologists until they told us what they knew.

We instructed participants to define a “site” as any contiguous patch of similar and suitable habitat surrounded by a different habitat type. Because of the great variation in survey methods and types of data we received, the actual designation of sites in our database is highly inconsistent. These range from specific locations of individual Cerulean Warblers within a larger contiguous area, to politically defined State Park or Wildlife Management Area boundaries, to entire river valleys with their adjacent slopes. In all cases; however, a “site” represents a *unique latitude and longitude* provided by a participant and entered into our database. Although this variation leads to difficulties in interpreting numbers or proportions of sites occupied in various regions or states, this flexibility in our protocols enabled us to receive the maximum amount of data from the widest group of volunteers and collaborators.

All sites were located on topographic maps, and data on habitat, landscape characteristics, and land ownership were noted on simple data forms. Specifically, field observers recorded site location, latitude and longitude, elevation, history of disturbance, general habitat type (riparian, swamp forest, dry slope, etc.), three or more dominant tree species, and canopy height. This information was compiled and entered into a GIS database by Lab of Ornithology biologists.

RESULTS

Range-wide Summary

A total of 280 CEWAP participants and collaborators reported data on Cerulean Warblers; these included 29 paid field assistants hired over the 3-year period (Table 1; see also Appendix 1 for complete list of CEWAP participants). The sum of data we received accounted for 7,669 Cerulean Warblers at 1,923 sites in 28 states, plus Ontario. Virtually all reports were of singing males; therefore numbers reported throughout this

Atlas are assumed to represent number of territorial males or breeding pairs. An additional 355 sites were searched with no birds found; in general observers only reported positive sightings, and these do not represent random samples of available areas or habitats. Note too, that “sites” ranged in scope from individual point-locations to whole river valleys, so these data provide only a rough indication of number of different areas that support Cerulean Warbler populations.

Table 1. Summary of CEWAP participants, numbers of sites, and number of Cerulean Warblers reported, by state, 1997–1999.

<i>State</i>	<i>Number of participants signed up</i>	<i>Number returning data</i>	<i>Number of sites surveyed</i>	<i>Number of sites with birds</i>	<i>Number of birds found</i>
Alabama	7	1	6	6	7
Arkansas	12	4	48	46	145
Connecticut	22	7	20	13	34
District of Columbia	4	0	-	-	-
Delaware	6	2	7	7	10
Georgia	18	5	16	14	22
Iowa	9	2	9	9	22
Illinois	26	3	32	21	1000+
Indiana	22	8	73	34	342
Kansas	1	1	1	1	1
Kentucky	17	8	113	59	140
Massachusetts	22	6	11	10	18
Maryland	17	6	11	9	16
Maine	4	0	-	-	-
Michigan	36	15	183	176	507
Minnesota	17	4	57	57	103
Missouri	14	5	32	31	301
Mississippi	2	0	-	-	-
Nebraska	2	1	1	1	1
New Hampshire	5	0	-	-	-
New Jersey	18	7	32	31	157
New York	159	57	286	246	1068
North Carolina	19	12	42	39	109
Ohio	46	17	78	62	264
Oklahoma	2	0	-	-	-
Ontario	9	1	5	4	228
Pennsylvania	81	38	206	182	548
Rhode Island	3	1	1	0	0
South Carolina	3	0	-	-	-
South Dakota	2	2	2	2	3
Tennessee	27	14	488	485	1210
Virginia	48	15	106	64	152
Vermont	13	2	4	3	3
Wisconsin	25	10	60	59	174
West Virginia	68	27	345	254	1124
TOTALS	786	280	2274	1923	7669

The scope and distribution of rangewide surveys is illustrated in Map 1 (frontispiece). Populations were surveyed throughout the entire range of the species, although coverage in many areas was patchy or incomplete. The largest number of birds were found in Tennessee, West Virginia, New York, and Illinois (Table 1; see state summaries below). These numbers require additional interpretation; however, because relative coverage of available sites varied greatly among states. For example, coverage was fairly complete near the periphery of the species' range (counts in NY and IL therefore may be close to total state populations), whereas only a sample of areas was covered in states near the center of the range (WV, TN, PA, KY).

The largest gaps in our overall atlas coverage were in Kentucky (entire state), western Maryland and Virginia, southern Ohio, and the Missouri Ozarks. In addition, many areas of West Virginia, Pennsylvania, Arkansas, and southern Indiana were only partially surveyed.

Although population estimates may not be representative for many states, CEWAP identified a large number of specific areas that are currently known to support significant populations of Cerulean Warblers. For ex-

ample, nearly 60% of all birds found were concentrated in 37 geographic areas in 16 states and Ontario (Table 2). Areas with the largest concentrations included the Cumberland Mountains northwest of Knoxville, Tennessee, the Montezuma Wetlands Complex and adjacent areas in central New York, Kaskaskia River Valley and Shawnee National Forest in southeastern Illinois, Jefferson Proving Ground of southern Indiana, Queens University Biological Station in southeastern Ontario, Kalamazoo River of southwestern Michigan, the Eleven Point and Upper Current Rivers in Missouri, Shenandoah National Park and Blue Ridge Highway in western Virginia, and the Delaware River Valley and adjacent highlands of northwestern New Jersey. The total population in West Virginia, Kentucky, and western Pennsylvania is certainly much higher than these numbers, but Cerulean Warblers are less concentrated in specific areas (i.e. the habitat is more continuous).

An additional 36 areas supported from 20-50 singing male Ceruleans and accounted for another 978 (13%) of the total birds detected (Table 3). These may represent secondary areas for long-term monitoring of Cerulean Warbler populations.

Table 2. Areas supporting the largest Cerulean Warbler populations (≥ 50 pairs), rangewide. These locations may represent primary areas for future population monitoring. See state summaries for more specific locations and information on these areas.

<i># Birds</i>	<i>State</i>	<i>Area</i>	<i>Habitat Type</i>
430	TN	Royal Blue Wildlife Management Area, Cumberland Plateau	Mesic slopes, cove forest
325	NY	Montezuma Wetlands Complex	Riparian, forested wetland
300+	IL	Kaskaskia River	Mixed floodplain
238	TN	Center Hill Lake Area, Edgar Evins State Park	Mesic slope, dry slope
202	IN	Jefferson Proving Ground	Mesic upland forest
200	ON	Bedford/Queen's University Biological Station	Upland, bottomland
200+	IL	Illinois Ozarks, Shawnee National Forest	White-oak dominated forest slopes
177	MI	Kalamazoo River, Alleghen State Game Area	Riparian, swamp forest
167	NY	Alleghany State Park and vicinity	Riparian, dry slopes
150+	IL	Cave/Cedar Creek	Sycamore-boxelder
142	TN	Frozen Head State Park	Mesic slopes
138	NY	Iroquois NWR, Oak Orchard WMA, Tonowanda Indian Reservation	Riparian, forested wetland
137	MO	Eleven Point River	Riparian
121	AR	Ozark National Forest	Upland, bottomland
114	MO	Upper Current River	Riparian
108	VA	Blue Ridge Parkway, Shenendoah National Park	Dry slope, mesic cove forest
100+	IL	Pere Marquette State Park, Big Rivers	White oak-pecan-black locust
100	MI	Fort Custer and vicinity	Dry upland forest
95	NY	Galen Wildlife Management Area	Riparian, forested wetland
94	WV	New River Gorge—Garden Ground Mountain Area	Dry slopes, riparian
90	NJ, PA	Delaware River Valley	Riparian, adjacent slopes
78	WV	Kanawha State Forest	Mesic cove forest, dry slope, riparian
78	WV	Guyandotte Mountain and vicinity	Upland forest
75+	KY	Daniel Boone National Forest	Upland forests
75	TN	Chickasaw National Wildlife Refuge	Riparian swamp forest
71	WI	Lower Wisconsin River drainages	Riparian, adjacent slopes
69	PA	Jennings Environmental Center, Moraine State Park	Dry slope, lake margin
65	WV	Louis Wetzel WMA	Dry slope, riparian
63	NY	Salmon Creek	Riparian, mesic slope
60	NC	Blue Ridge Parkway, Pisgah National Forest	Dry slope, cove forest
56	OH	Shawnee State Park and Forest	Dry slope, riparian
54	TN	Meeman Shelby State Park, Mississippi Delta region	Mesic slope, riparian
50+	IL	Mississippi Palisades State Park and vicinity	White oak-walnut-black locust forest
50+	IL	Rock River	Riparian forest
50	NJ	Kittatinny Mountains	Mesic and dry slopes
50	WV	Beech Fork State Park	Lake margin, dry slope
50	WV	North Bend State Park and Rail Trail, Mountwood Park	Dry slope, cove forest, riparian

Table 3. Areas supporting moderate-sized (20–50 singing males) *Cerulean Warbler* populations rangewide. These locations may represent secondary areas for long-term monitoring.

<i># Birds</i>	<i>State</i>	<i>Area</i>	<i>Habitat Type</i>
45	OH	Lake Metroparks	Riparian, dry slope
44	MI	Waterloo Recreation Area	Dry upland forest
42	PA	Juniata River and vicinity	Riparian
40	WV	Greenbrier River drainage and adjacent mountains	Dry slopes
36	WV	Fork Creek WMA—Little Coal River and vicinity	Riparian, mesic slope
34	OH	Zaleski State Forest/ Lake Hope State Park	Mesic slope, dry slope
34	MO	Curtois Creek	Riparian
33	NY	Bear Mountain State Park	Dry slope, bottomland
32	OH	Waterloo Township—Hewett Fork	Dry slope, mesic slope
32	TN	Cheatham Wildlife Management Area	Dry slope, mesic slope
31	WI	Lower Wisconsin River	Riparian, mesic slope
29	OH	Cuyahoga Valley National Recreation Area, Brecksville Reservation—Cleveland Metroparks	Riparian, dry slope
29	PA	Peter’s Mountain and State Game Lands	Dry slope, lake margin
28	TN	Natchez Trace Parkway, National Park	Dry slope, mesic slope
28	WV	Murphy Preserve	Moist cove forest, dry slope, riparian
26	NY	Castleton Island State Park	Riparian, river island
25	NJ	Hamburg Mountain and vicinity	Dry slope, lake margin
25	TN	Mill Creek Rd.	Dry slope
24	MI	White River	Riparian
24	WI	Wyalusing State Park	Dry slope, mesic slope
23	PA	Brady’s Run County Park	Dry slope
23	WV	Coopers Rock State Forest	Mesic slope, dry ridgetop
22	MI	Brown County State Park	Upland, lake margin, riparian
22	PA	Forbe’s State Forest and vicinity	Dry slope
22	VA	Canoe Lake—Hahn Property	Upland
22	WV	Ritchie Mines WMA	Dry slope
21	MI	St. Joseph River	Riparian
20	IL	Illinois River Valley	Cottonwood-oak floodplain forest
20	IL	Cache River	Mixed floodplain forest
20	MN	Murphy-Hanrehan Park Reserve and County Park	Riparian, mesic slope
20	NY	Letchworth State Park	Riparian
20	NY	West Point Military Reservation	??
20	PA	Duff Park and Boyce Park	Dry slope, riparian
20	PA	Ten Mile Creek and vicinity	Riparian, dry slope
20	VA	Clinch Ranger District, Jefferson National Forest	Dry slope, cove forest
20	WI	Lake LaGrange	Mesic slope

Regional Summaries

USFWS Region 3

Within USFWS Region 3, CEWAP participants found a total of 1,745 Cerulean Warblers at roughly 439 sites. This does not include data from Illinois, provided by Scott Robinson, which accounted for an additional 1,000–3,000 birds in that state. CEWAP coverage was patchy throughout the region, with the most concentrated efforts in southern Michigan, southeastern Missouri, and southern Indiana. A scattering of Cerulean populations were located along the Mississippi River and its major tributaries in the upper Midwest, and in the Ohio River drainage along the southern boundary of the region. The largest single populations in the region are believed to be located in Illinois along the Kaskaskia River and Illinois Ozarks region (500+ pairs), Jefferson Proving Ground in southern Indiana (200+ pairs), Kalamazoo River and Fort Custer areas in Michigan (275+ pairs), and along the Eleven Point and Upper Current Rivers in Missouri (250 pairs). Coverage was poorest in southern Ohio and elsewhere in Indiana and Missouri, where undoubtedly many other populations exist (Map 2.)

Overall, Cerulean Warblers showed a distinctly bimodal habitat distribution, with roughly the same numbers of birds found occupying bottomland and upland habitats. Among the 426 specific sites with habitat data, roughly 40% were in riparian bottomland forest, accounting for 485 of the Ceruleans found (not counting Illinois). An additional 305 of sites were in dry upland forest and 225 were in mesic uplands, accounting for 21% and 28% of the birds found, respectively (Figure 1).

For 164 sites in Region 3, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 41% of occupied

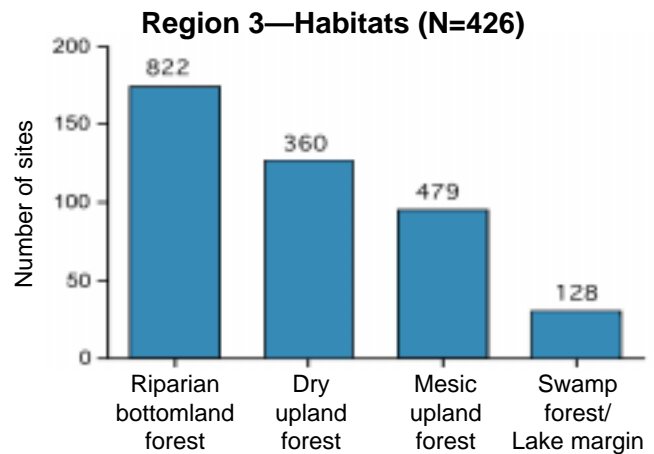
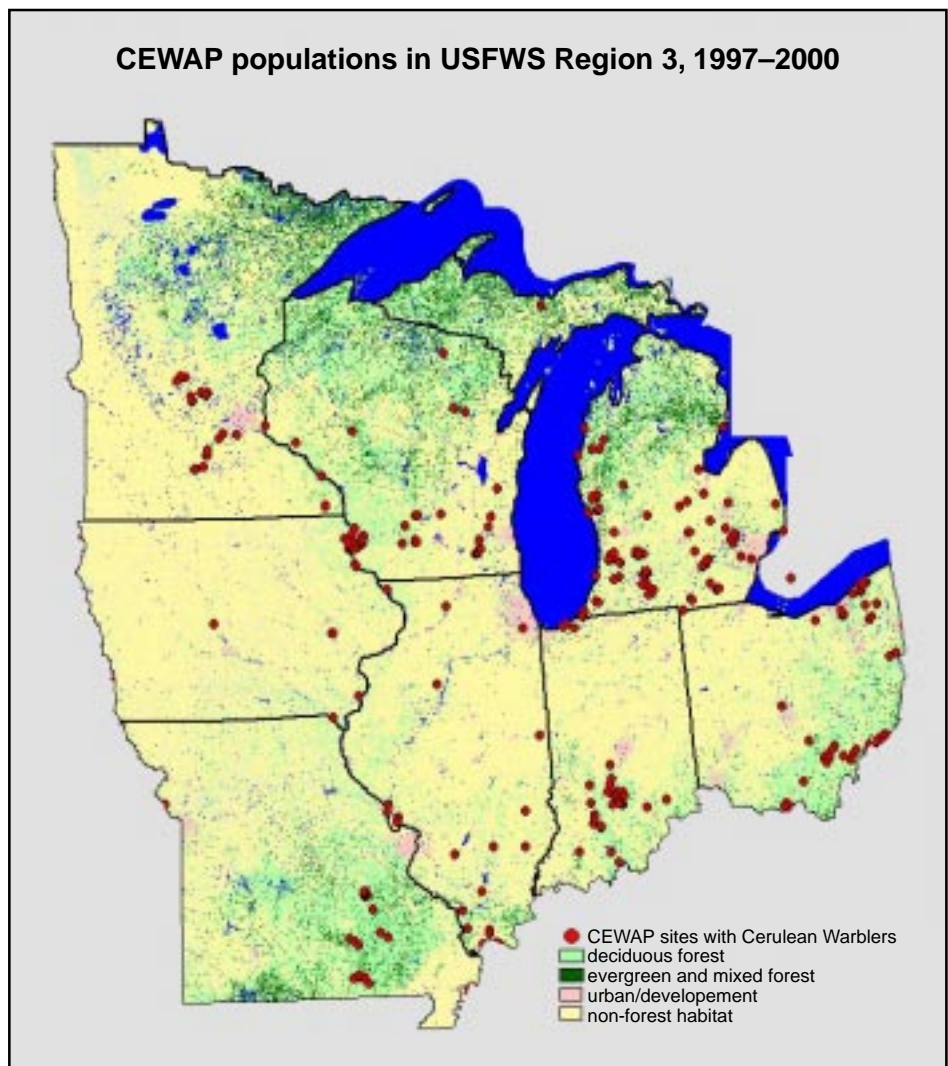


Figure 1. Habitat classifications at sites with Cerulean Warblers in USFWS Region 3. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.



Map 2. Cerulean Warbler populations and land cover types for USFWS Region 3.

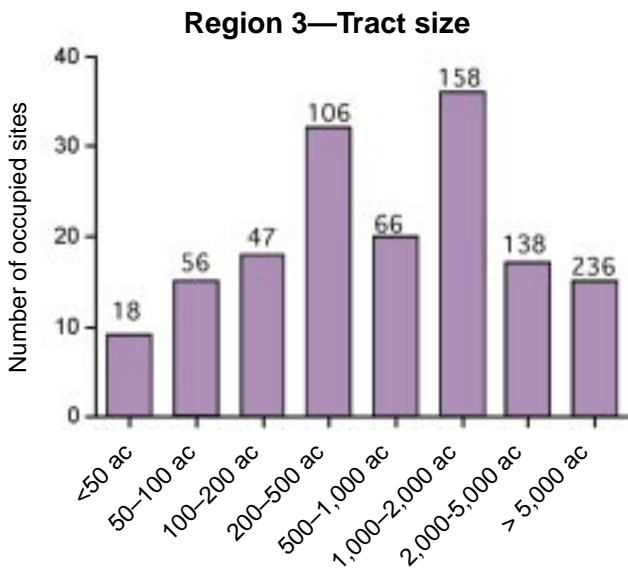


Figure 2. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 3. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

sites were described as 1,000 acres or greater, accounting for 65% of all birds found (Figure 2). An additional 265 birds were found in 70 tracts between 200 and 1,000 acres, and fewer than 10% of the birds were in patches \leq 100 acres.

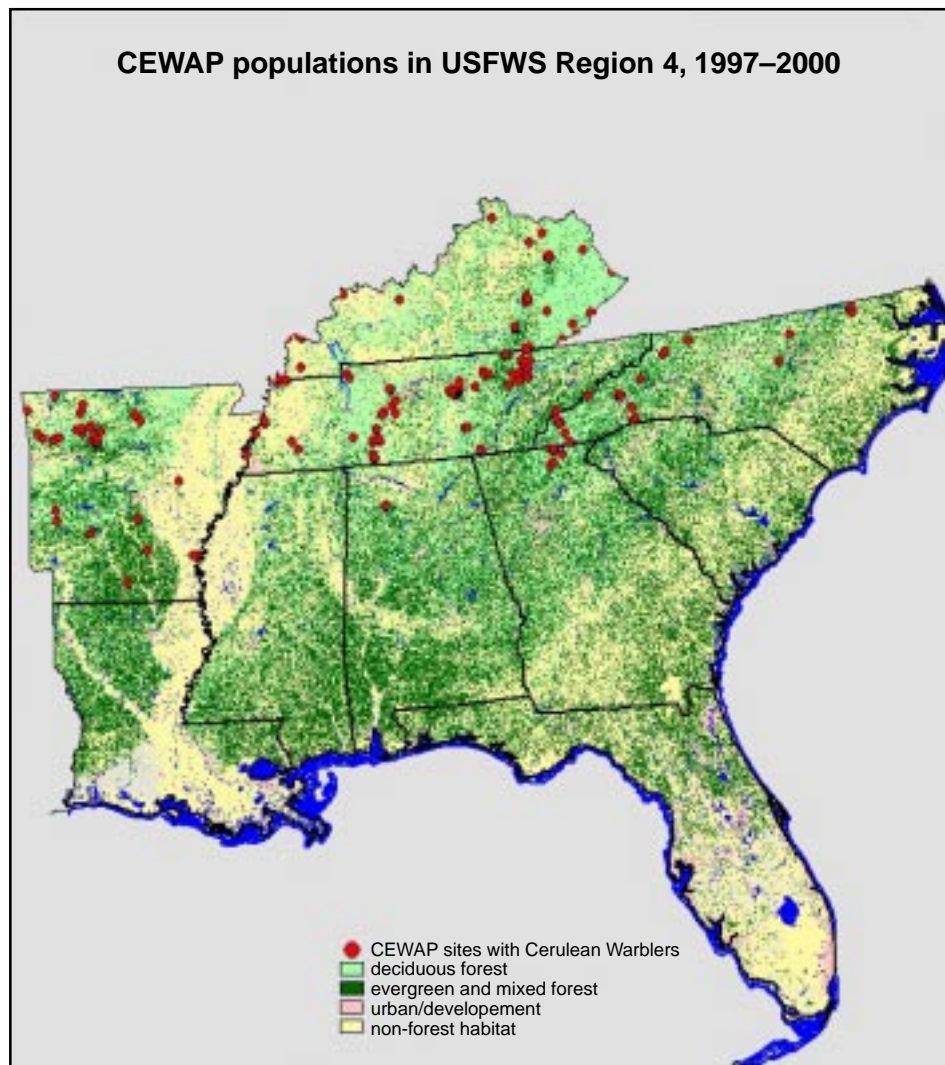
USFWS Region 4

In the Southeast region, CEWAP participants and collaborators found a total of 1,560 Cerulean Warblers at 633 specific sites (Map 3). Coverage was patchy throughout the region, ranging from intensive surveys of several key areas in Tennessee to scattered observations from many other areas. The biggest holes in atlas coverage were in eastern Kentucky. The largest Cerulean population in the region is undoubtedly in the Cumberland Mountains and Plateau areas of Tennessee and probably Kentucky. Additional significant populations were located in the Blue Ridge of North Carolina, the Ozarks of Arkansas, and in

central Tennessee. Small populations were documented at the edge of the species' range in northern Georgia, northern Alabama, and the coastal plain of North Carolina (Roanoke River). No recent breeding records could be obtained in Mississippi, South Carolina, or Louisiana.

Of 550 specific sites reporting habitat data, the majority (73%) were in mesic upland and moist cove forest habitats, accounting for 575 of the birds found throughout the region (Figure 3). An additional 265 birds were found at 70 dry slope and ridgetop sites, whereas only 13% of birds were in riparian forest habitat.

For 117 sites in Region 4, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 74% of occupied sites were described as 1,000 acres or greater in extent, accounting for nearly 95% of all birds found (Figure 4). Only 4% of the birds found in this region were in habitat patches \leq 200 acres.



Map 3. Cerulean Warbler populations and land cover types for USFWS Region 4.

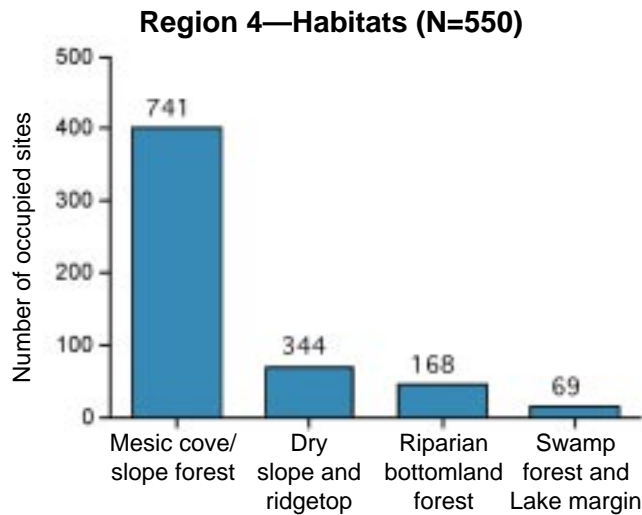


Figure 3. Habitat classifications at sites with Cerulean Warblers in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

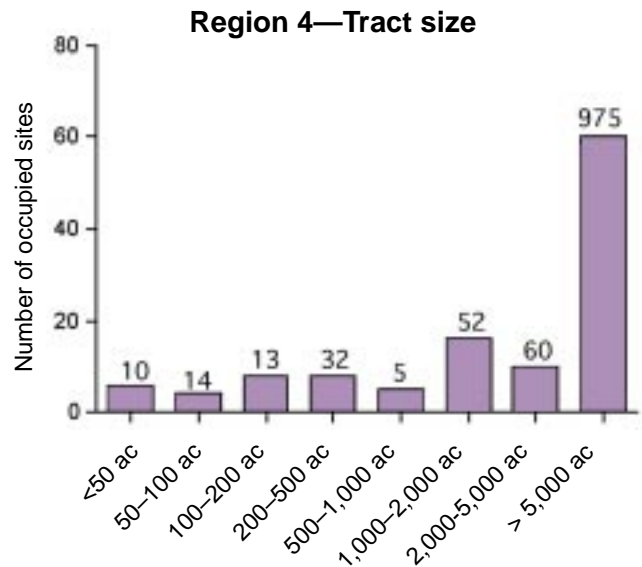
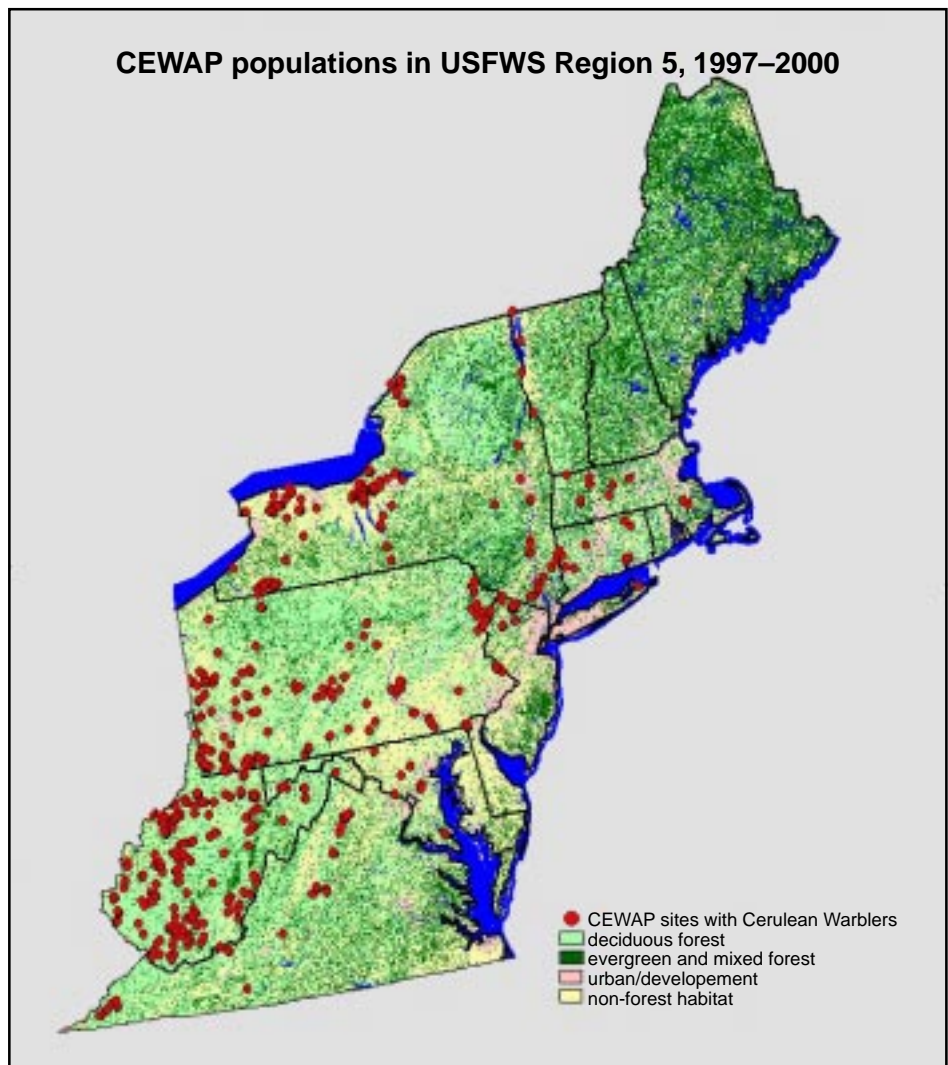


Figure 4. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

USFWS Region 5

In the Northeast Region, a total of 3,077 Cerulean Warblers were located at 820 specific sites (Map 4). Intensive surveys at many sites in West Virginia and western Pennsylvania turned up roughly 1,400 Ceruleans in the heart of the species’ range—this is undoubtedly only a small fraction of the true population in these states. Outside of the Ohio Hills physiographic area, large and significant populations were documented in several areas including the Montezuma Wetlands complex and surrounding areas in central New York (400+ pairs), Allegheny State Park and National Forest area of western New York and Pennsylvania (175+ pairs), the Delaware Water Gap region of northwestern New Jersey and adjacent Pennsylvania (150+ pairs), and the Blue Ridge Parkway area of western Virginia (100+ pairs). In addition, smaller populations exist in



Map 4. Cerulean Warbler populations and land cover types for USFWS Region 5.

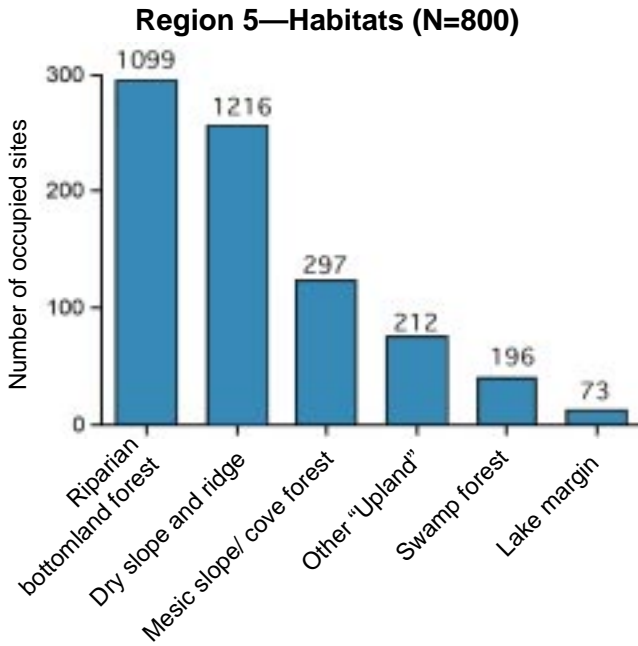


Figure 5. Habitat classifications at sites with Cerulean Warblers in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

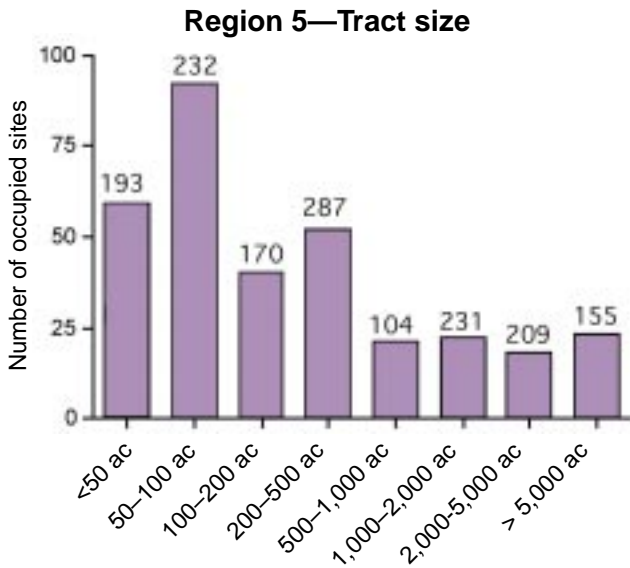


Figure 6. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 5. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

the Hudson River Valley and Highlands of southeastern New York, and in many parts of Pennsylvania. Small but persistent populations were found throughout southern New England, in northern New York, and in the Piedmont of Maryland and Virginia. Finally, although not in this USFWS Region, a large population of Cerulean Warblers exists in Ontario, not far from the New York border.

As in other regions, Cerulean Warblers exhibit a distinctly bimodal habitat distribution in the Northeast. Of the 800 specific sites with habitat data, 43% were in riparian or other bottomland forest habitats, accounting for 44% of individual Ceruleans found (Figure 5). An additional 39% of birds were found at 256 dry slope or ridgetop sites, with the remainder of birds in other upland habitats.

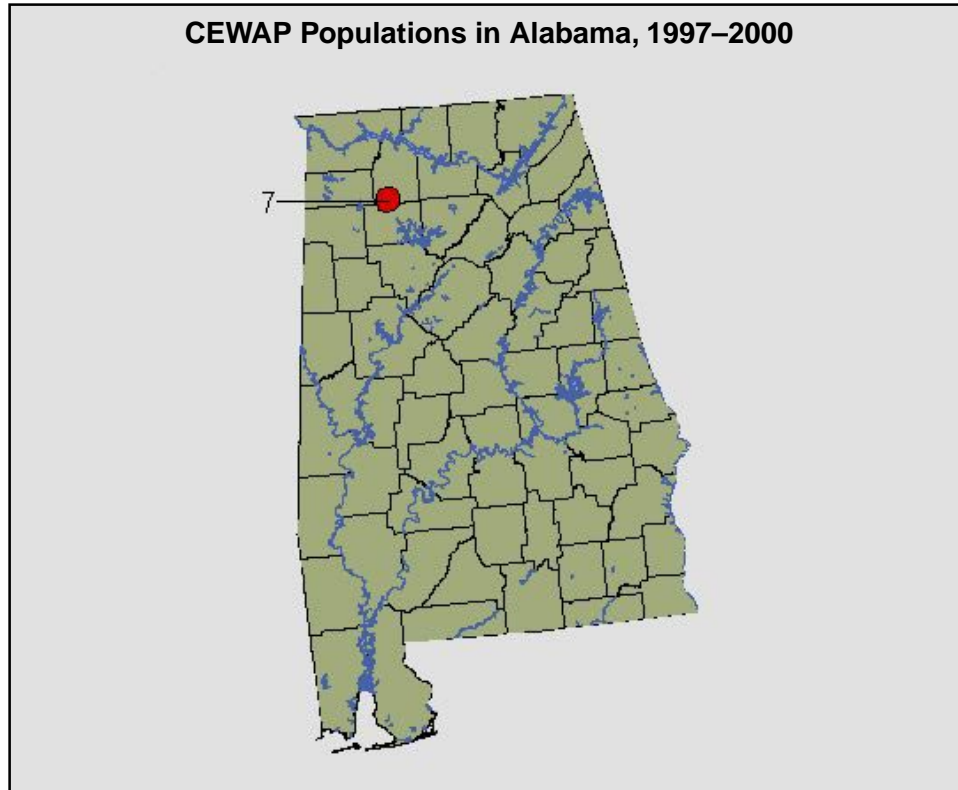
For 333 sites in Region 5, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 19% of occupied sites were described as 1,000 acres or greater in extent, accounting for 40% of all birds found (Figure 6). This is a much lower proportion than in the other two regions. In contrast, 57% of occupied sites were described as ≤ 100 acres, supporting 29% of the Ceruleans found in this region. Whether these data indicate a lower threshold of area sensitivity by Cerulean Warblers in the Northeast, compared with other regions, or whether the range of available habitats searched was different, is unclear.

State Summaries

Alabama

Our current data for Alabama (Map 5) comes from Eric Soehren (e-mail communication, Oct. 2000), who reported birds from two sites in the Bankhead National Forest (Lawrence and Winston counties). Five birds were

observed in the Sipsey Wilderness and 2 were noted along Flannagin Creek. The total population for this area is thought to possibly be much larger, and more systematic surveys are recommended.



Map 5. Cerulean Warbler populations in Alabama. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

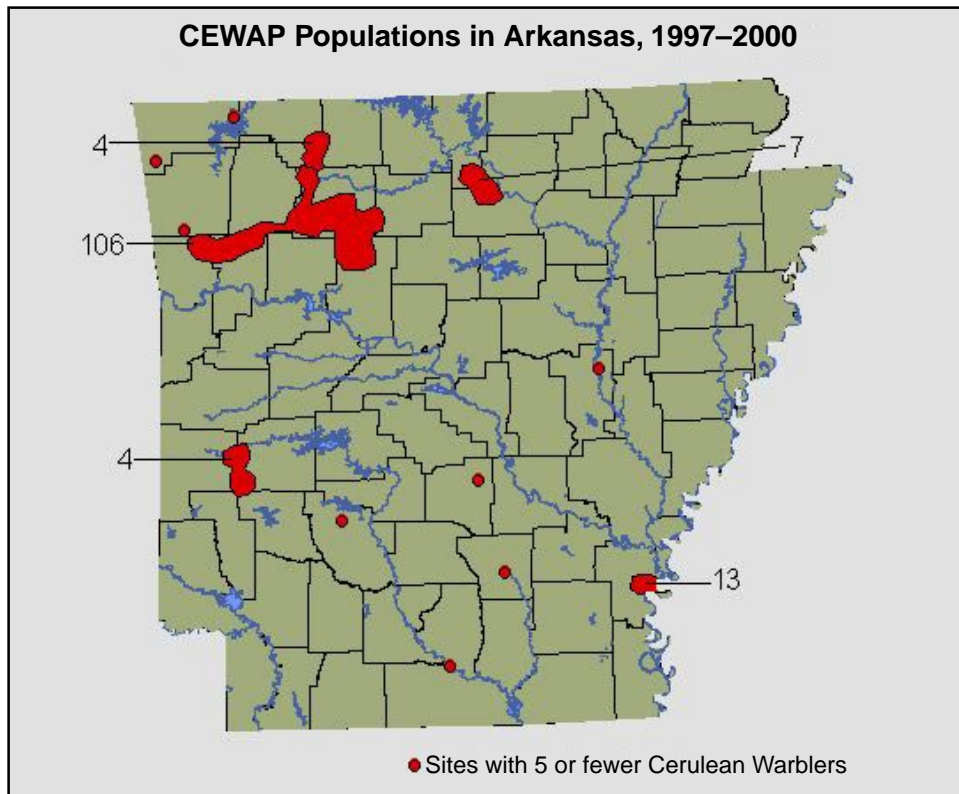
Arkansas

There is little published information on the presence/absence or relative abundance of Cerulean Warblers in Arkansas; however, Hamel (2000) does cite a few references suggesting that the species is common in the Ouachita National Forest and western Ozarks. The primary area searched by CEWAP participants was the Ozark National Forest in the northwestern part of the state (Map 6). It is likely that additional populations exist in the Ouachita National Forest and unsearched areas of the Mississippi Delta region.

CEWAP participants observed 145 birds at 46 (96%) of 48 sites visited in Arkansas. Of these, 121 (83%) were noted in the Ozark National Forest and 14 (10%) were detected in Desha and Prairie counties of the Mississippi Delta region (Table 4). No birds were discovered at two separate sites along the Ouachita River (near Callion) and the Saline River (near Rison). Data from the Ozark National Forest consisted of individual Cerulean Warblers reported on point counts; it is unclear how complete this sampling was for the species in this region.

Table 4. Important areas for breeding Cerulean Warblers in Arkansas.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
121	Ozark National Forest	6 counties	Upland, bottomland	750–2250
14	Mississippi Delta region	Desha, Prairie	Bottomland	145–183



Map 6. Cerulean Warbler populations in Arkansas. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Of the 46 sites with Ceruleans, 35 (76%) were classified as upland and 12 (25%) were bottomland (Figure 7). Upland sites accounted for 113 (79%) Cerulean observations, whereas 30 (21%) birds were observed in bottomland habitats.

Among the 33 sites that recorded tree species, upland sites were dominated by oaks (mostly red oak) and hickories, whereas bottomland sites reported sweetgum, maples, and sycamore (Figure 8).

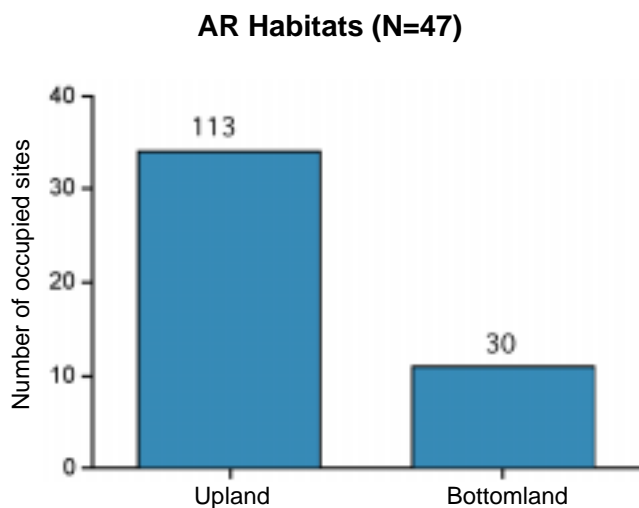


Figure 7. Habitat classifications at sites with Cerulean Warblers in Arkansas. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

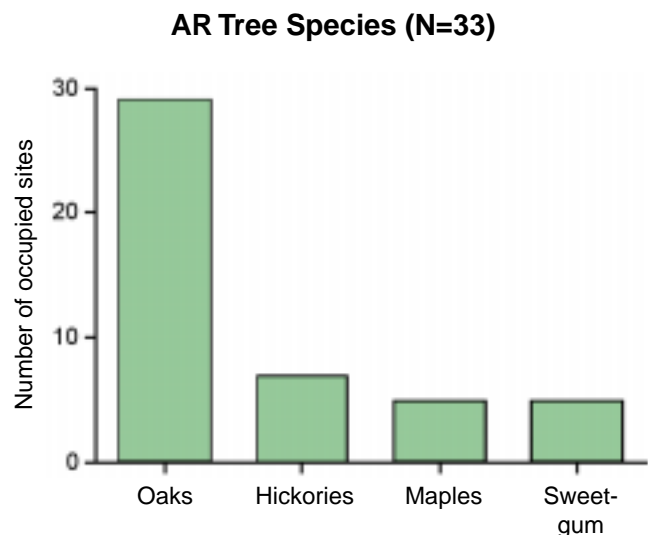


Figure 8. Predominant tree species reported at occupied sites in Arkansas. “N” equals number of sites with tree species reported by CEWAP participants.

Connecticut

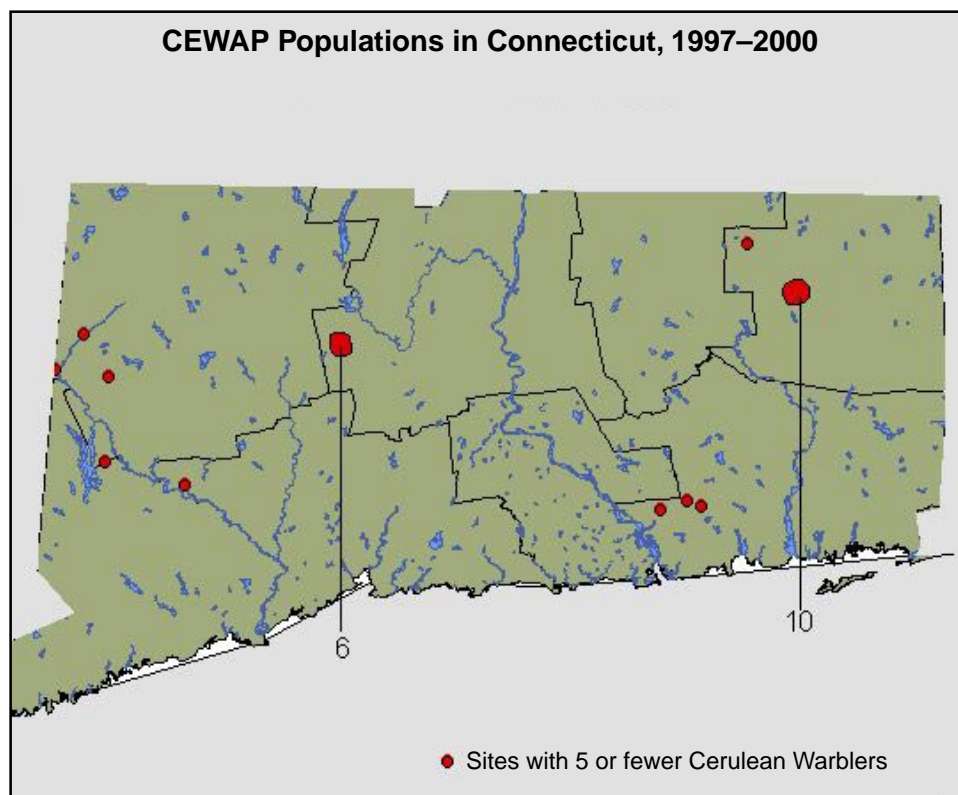
The *Atlas of Breeding Birds in Connecticut* reported Cerulean Warblers from 6.5% of all atlas blocks (Bevier 1994). CEWAP coverage in Connecticut was patchy, but distributed in several regions. Ceruleans were observed in all regions searched, except the extreme southwest corner near the towns of Redding and Weston (Map 7).

CEWAP participants counted 34 birds at 13 (65%) of 20 sites visited in Connecticut. Of the 34 individuals, 10 (29%) were noted in Natchaug State Forest in Windham County. Other important areas for Ceruleans included habitat along the Housatonic River in Litchfield County and the Session Woods Wildlife Management Area in Hartford County (Table 5). Additional single birds were found at Kahn Preserve near New Milford, Nehantic State Forest near Lyme, Bend of the River

Audubon Center near Southbury, and the Yale Forest in Windham County. Among the areas searched that did not have Ceruleans were Devil's Den Preserve and Limekiln Natural area in Fairfield County.

Riparian and other bottomland sites accounted for 16 of the 34 cerulean observations, whereas 12 Ceruleans were noted in upland forest habitats (Figure 9).

Oaks and maples were the most commonly reported tree species at occupied sites; however, birch, hickory, sycamore, and eastern hemlock were also reported (Figure 10). The Natchaug State forest is a 12,500 acre site dominated by red oak, white oak, black oak and hickory, whereas sites along the Housatonic River had sycamores, red and silver maples, white oaks, and ash.



Map 7. Cerulean Warbler populations in Connecticut. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 5. Important areas for breeding Cerulean Warblers in Connecticut.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
10	Natchaug State Forest	Windham	Lake margin, dry slope	??
6	Housatonic River—Kent, Bull's Bridge	Litchfield	Riparian	370
5	Session Woods WMA	Hartford	Riparian	750
3	Pleasant Valley Nature Preserve	Middlesex	??	??
3	Hartman Park, Lyme	Middlesex	??	??
2	Still River Preserve	Litchfield	Riparian	250

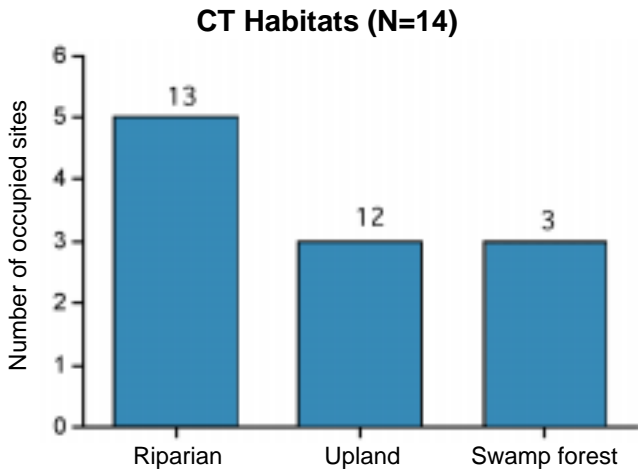


Figure 9. Habitat classifications at sites with Cerulean Warblers in Connecticut. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

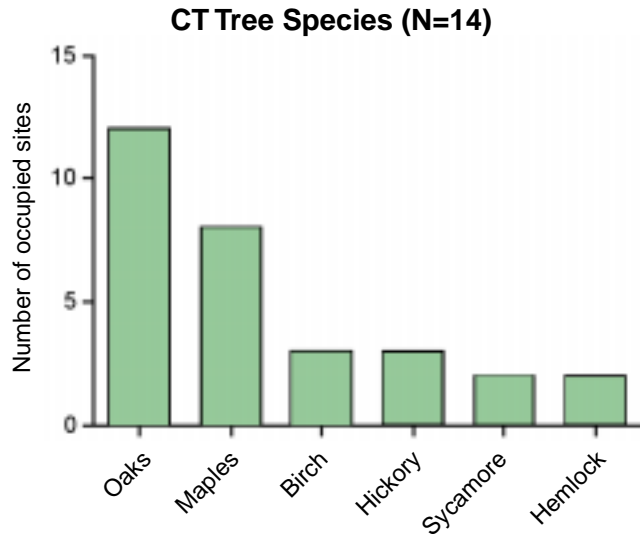


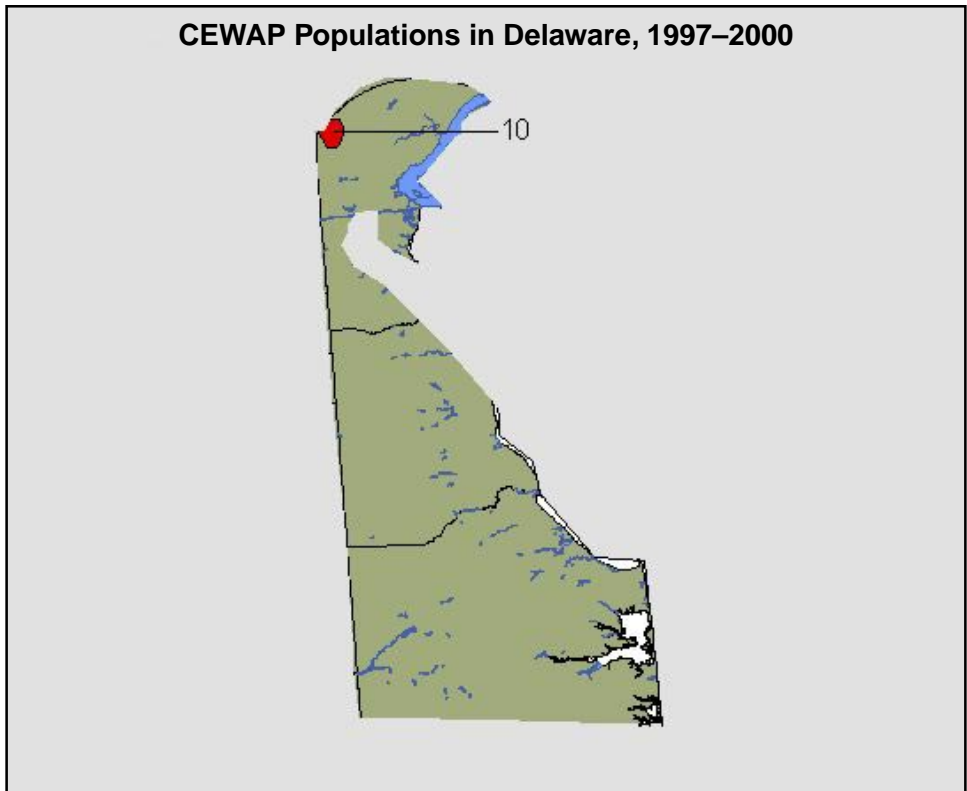
Figure 10. Predominant tree species reported at occupied sites in Connecticut. “N” equals number of sites with tree species reported by CEWAP participants.

Delaware

Hamel (2000) reported that “Preliminary results from the Delaware Breeding Bird Atlas indicate the birds were found in two blocks in the northern part of the state (Lisa Gelvin-Innavaer, pers. comm., 18 Sept. 1996).”

CEWAP participants counted 10 Cerulean Warblers at 7 sites in the northern Delaware county of New Castle

(Map 8). All these birds were along White Clay Creek in riparian and adjacent upland forest. The forest was dominated by sycamore, maples, tulip tree, and walnut. This area is adjacent to a site with two additional birds at the White Clay Creek Preserve in Chester County, PA.

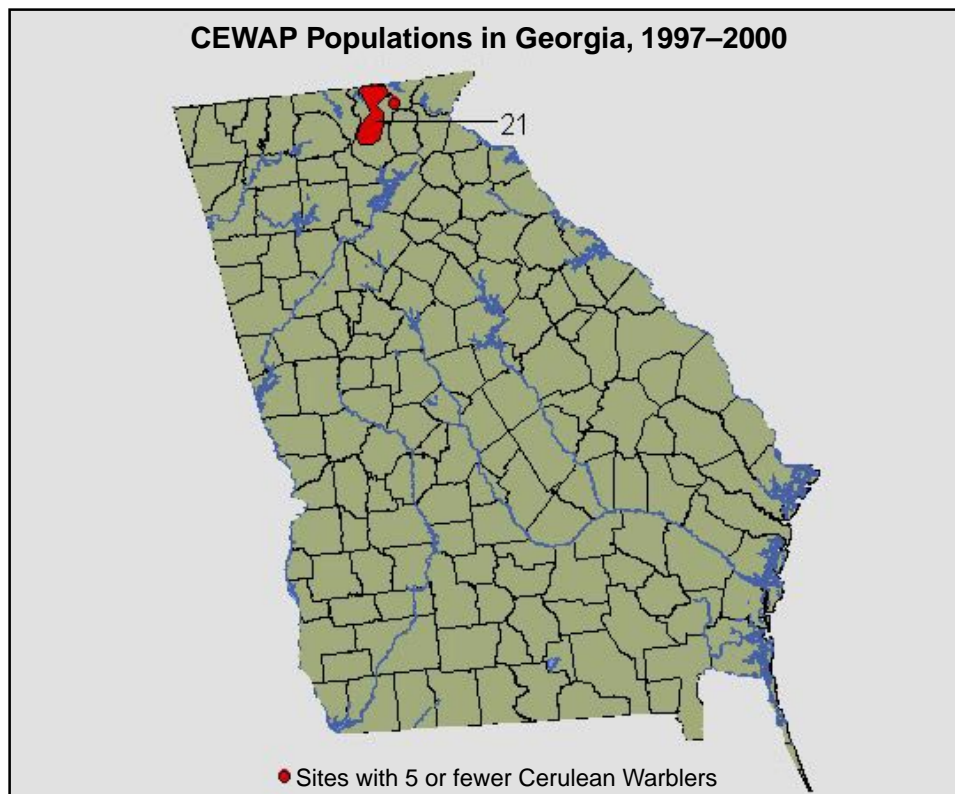


Map 8. Cerulean Warbler populations in Delaware. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Georgia

CEWAP surveys yielded 22 birds at 14 (87%) of 16 sites visited (Map 9). Nearly all the birds were on the Chattahoochee National Forest in Union County, be-

tween 2,640 and 3,400 ft. elevation, either on dry slopes or in cove forest. Specific sites on the national forest included Walnut Knob, Poplar Knob, Rogers Knob, Steedly Mountain, and Rockface Lead.



Map 9. *Cerulean Warbler* populations in Georgia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Illinois

Our knowledge of Cerulean Warblers in Illinois comes primarily from Scott Robinson and Glendy Vanderah of University of Illinois at Urbana-Champaign, who completed statewide surveys for this species between 1992 and 1997. We are grateful to these researchers for sharing their unpublished data, which make up the bulk of our account, below. A few additional observers surveyed about 8 sites during the CEWAP, but we did not solicit participation in Illinois in light of the recently completed surveys (Map 10).

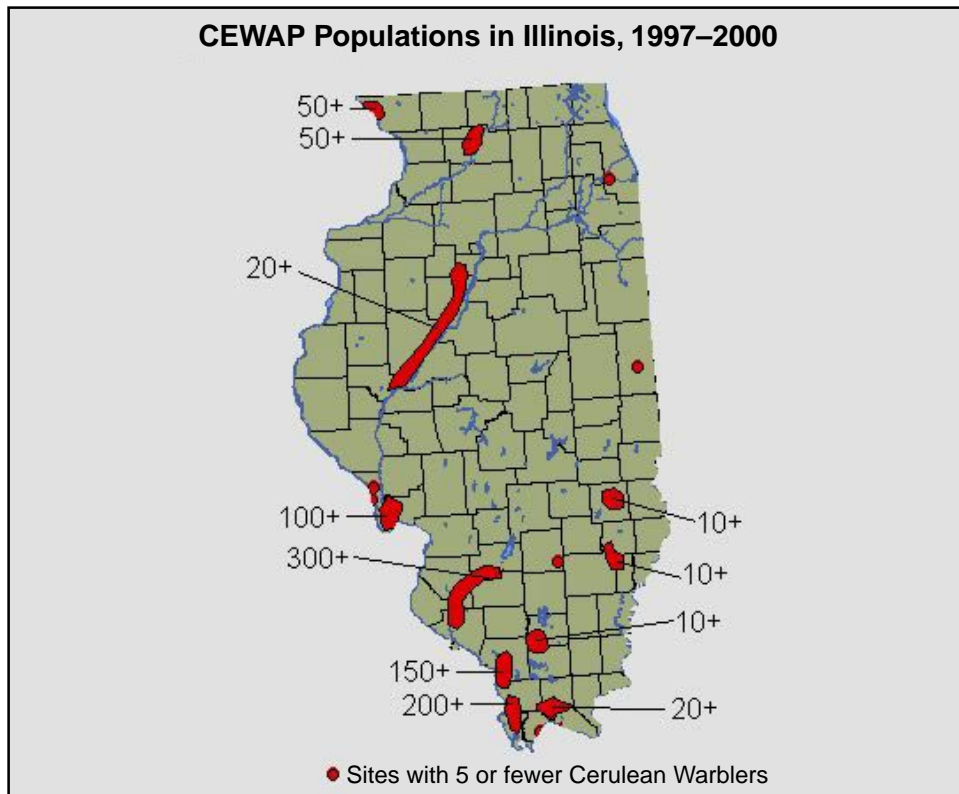
Robinson and Vanderah completed 2,587 census points and 253 census routes, sampling 117 forest tracts statewide. They estimated Cerulean Warbler abundance in 21 regions of the state and extrapolated to produce a range of population estimates for each area. The results of this ambitious survey yielded a statewide population of between 1,000 and 3,000 singing male Cerulean Warblers. More than 75% of these were concentrated in four areas in the southwest portion of the state—Kaskaskia River Valley, Pere Marquette State Park and

Big Rivers along the Mississippi River, Cave/Cedar Creek, and the Illinois Ozarks (Table 6). Smaller populations occur further north along the Mississippi River and along a few other river systems. The highest density of singing males (0.66 per 50-m point count) was found at the Cave/Cedar Creek sites.

Habitat selection varied across the state, with the majority of birds occupying tall, diverse floodplain forests or white-oak dominated slopes. An interesting situation occurred locally in black locust groves within larger forest tracts. At Pere Marquette State Park, Cerulean Warbler territories in black locust ranged from 2 (1996, 1997) to 15 (1996), presumably a response to local outbreaks of lepidopteran larvae on this tree species. Similarly, at Mississippi Palisades State Park, number of territories in black locust ranged from 1 in 1994 to 13 in 1992.

Cerulean Warblers in Illinois occurred with much greater frequency in larger forest tracts (Figure 11).

(Continued on page 19)



Map 10. *Cerulean Warbler* populations in Illinois. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 6. Important areas for breeding *Cerulean Warblers* in Illinois (data from Robinson and Vanderah, unpublished).

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
300–1,000	Kaskaskia River	Clinton, St. Clair, Washington	Mixed floodplain forest	420
200–500	Illinois Ozarks, Shawnee National Forest	Jackson, Union	White oak dominated slopes	400–600
150–300	Cave/Cedar Creek	Jackson	Sycamore, boxelder forest	??
100–200	Pere Marquette State Park, Big Rivers	Jersey	White oak-pecan-black locust forest	420–600
50–150	Mississippi Palisades State Park and vicinity	Carroll, Jo Daviess	White oak-walnut-black locust forest	500–750
50–100	Rock River	Ogle, Lee, Whiteside	Riparian	600
20–50	Illinois River Valley	various	Cottonwood-oak floodplain forest	450–600
20–50	Cache River	Johnson, Pulaski	Mixed floodplain forest	400–450
10–50	Till Plain region	various	??	420–450
10–20	Little Wabash River	White, Gallatin	??	420
10–20	Big Muddy River	Franklin	Mixed floodplain forest	420

Roughly half of 48 tracts ≥ 500 ac (200 ha) were occupied, whereas only 2 of 42 tracts < 80 ha (200 ac) had birds. Rates of nest parasitism by Brown-headed Cowbirds were relatively high; e.g. 75% in Illinois Ozarks and 80% at Mississippi Palisades State Park.

Robinson and Vanderah point out that Illinois is near the center of the Cerulean Warbler's historic range and that the species was abundant there during the 1800s. Today the species is "rare, patchy, and extremely area sensitive." They were found to be absent or very rare in (1) drier forests on poor or sandy soils; (2) pure tree plantations (pines, sweetgum, tulip-tree); (3) younger or heavily logged forests; (4) urban woodlots; and (5) forest patches < 200 ha (500 ac) that are scattered through the agricultural landscape.

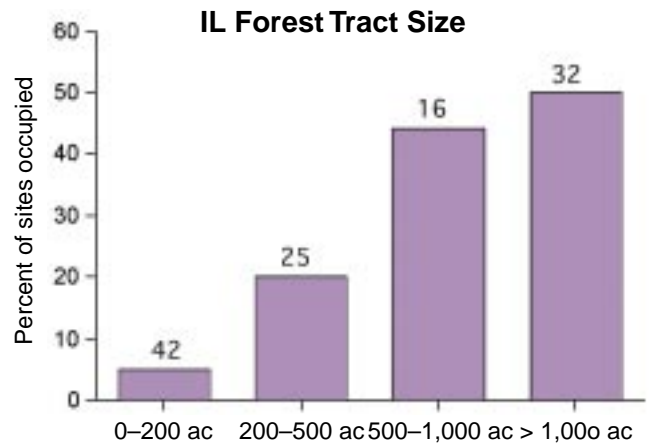


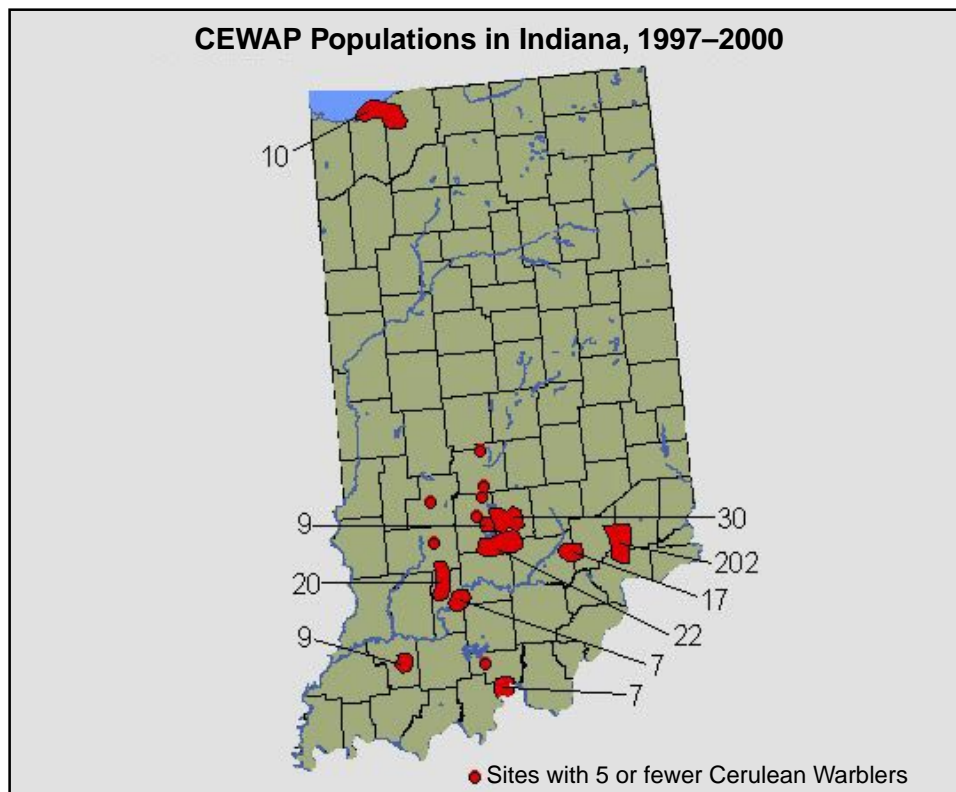
Figure 11. Percent of forest tracts in four size classes occupied by territorial Cerulean Warblers in Illinois. Numbers of sites sampled are above bars. Data from S. Robinson and G. Vanderah unpublished.

Indiana

The *Atlas of Breeding Birds of Indiana* (Bruner 1998) reports that Cerulean Warblers were found at 21% (347) of atlas blocks statewide. Ceruleans were most numerous in atlas blocks located in the southeastern and south-central portions of the state. CEWAP coverage in Indiana was confined primarily to the southern one-third of the state.

CEWAP participants counted 342 birds at 34 (47%) of 73 sites searched in Indiana. The 7,700-acre Jefferson

Proving Ground in Jefferson, Ripley, and Jennings counties accounted for 202 (59%) of the Cerulean sightings (Map 11). Other important areas included Brown County State Park and Muscatartuck National Wildlife Refuge, which combined accounted for 39 observations (Table 7). Roughly 60 birds were found at various locations in the vicinity of Lake Monroe southeast of Bloomington. An isolated population at Indiana Dunes on Lake Michigan consisted of at least 10 individuals.



Map 11. Cerulean Warbler populations in Indiana. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Although only 7 (21%) of the 34 sites were classified as mesic upland, this habitat type accounted for 247 (72%) of Cerulean observations (Figure 12). Roughly 97 birds were found in various bottomland and lake-margin habitats in Indiana, and an additional 34 individuals were found in dry upland forests.

Maples and sycamore were reported from the largest number of occupied sites (Figure 13); however, the site with the largest population (Jefferson Proving Ground) was dominated by white oak and tulip tree. Bottomland sites consisted primarily of sycamore and maples, with black walnut and elms also frequently reported.

Table 7. Important areas for breeding Cerulean Warblers in Indiana.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
202	Jefferson Proving Ground	Jefferson, Ripley, Jennings	Mesic upland forest	900
22	Brown County State Park	Brown	Upland, lake margin, riparian	650–750
17	Muscatartuck NWR	Jackson, Jennings	Swamp forest, mesic slope	550
10	Indiana Dunes National Lakeshore	Porter	Swamp forest, riparian	600–650
10	Turkey Creek Bottom	Martin	Bottomland	520
9	Gross Road	Monroe	Mesic and dry upland	550–720
9	Patoka River	Pike	Riparian	420
7	Little Blue River	Monroe	Riparian	400
7	Tank Spring Bottom	Martin	Bottomland	510–530
6	Goldsberry Hollow	Martin	Bottomland	480–510
5	Camp Roberts Cove	Brown	Bottomland	710–850
5	Rogers Road	Monroe	Moist Cove forest	660–770

IN Habitats (N=34)

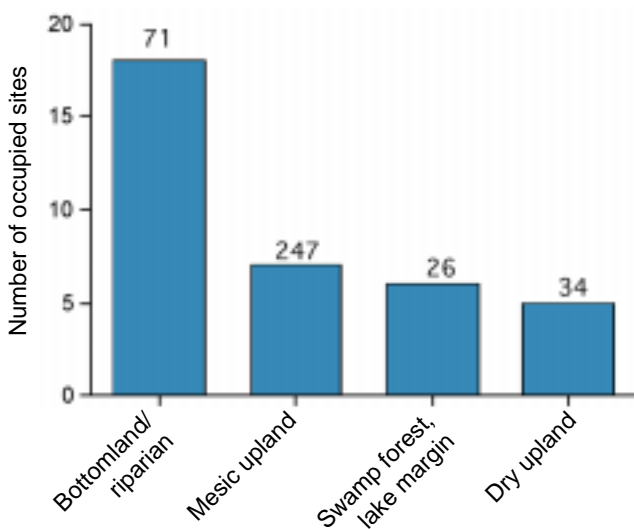


Figure 12. Habitat classifications at sites with Cerulean Warblers in Indiana. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

IN Tree Species (N=30)

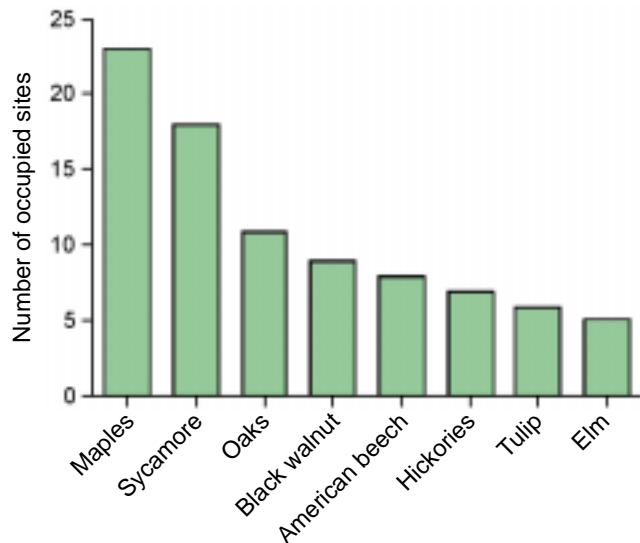


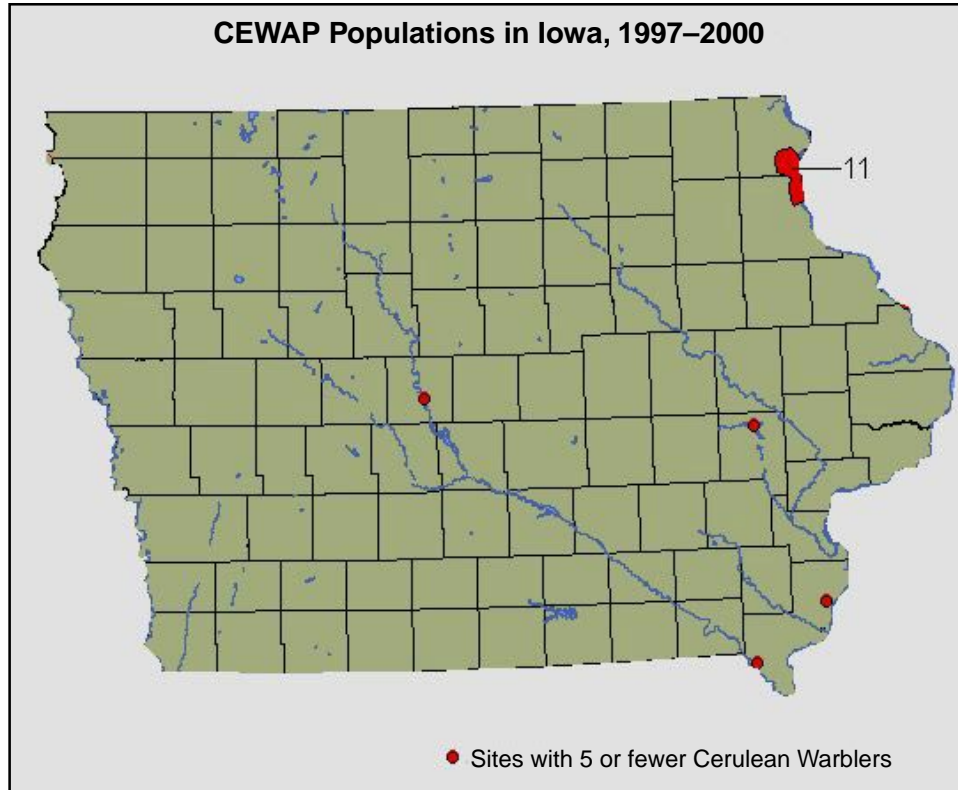
Figure 13. Predominant tree species reported at occupied sites in Indiana. “N” equals number of sites with tree species reported by CEWAP participants.

Iowa

The *Iowa Breeding Bird Atlas* reported ceruleans from 44 (6%) atlas blocks in 28 counties. However, these observations occurred mainly in priority blocks that had been selected because they contained large amounts of forest. Most reports were from extreme eastern Iowa

and the DeMoines River floodplain (Cecil 1996).

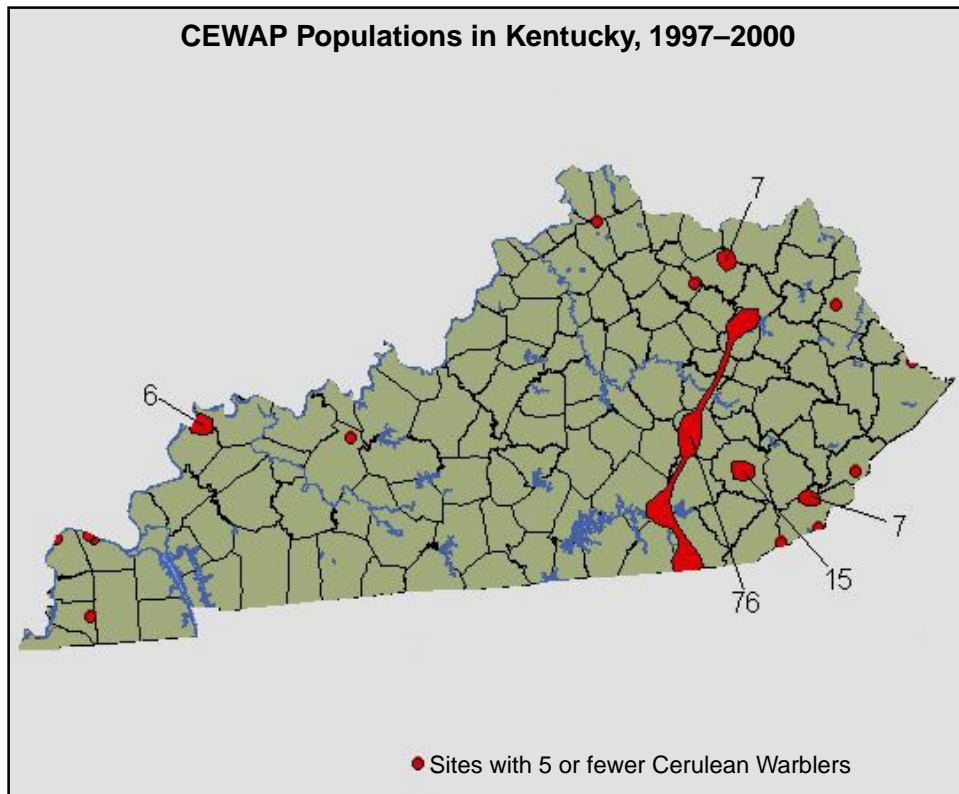
CEWAP participants tallied 22 ceruleans at 9 sites in 6 counties (Map 12). The most important sites were located along the Mississippi River in Allamakee and Clayton counties, where 11 birds were observed.



Map 12. *Cerulean Warbler populations in Iowa. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.*

Kansas

CEWAP participants documented 1 cerulean at the Western Bend Bottomlands on the Fort Leavenworth Military Reservation. The bird was in riparian forest dominated by sycamore, cottonwood, and ash. This was the only site surveyed by CEWAP. Other populations may exist in the eastern part of the state (Thompson and Ely 1992).



Map 13. *Cerulean Warbler* populations in Kentucky. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Kentucky

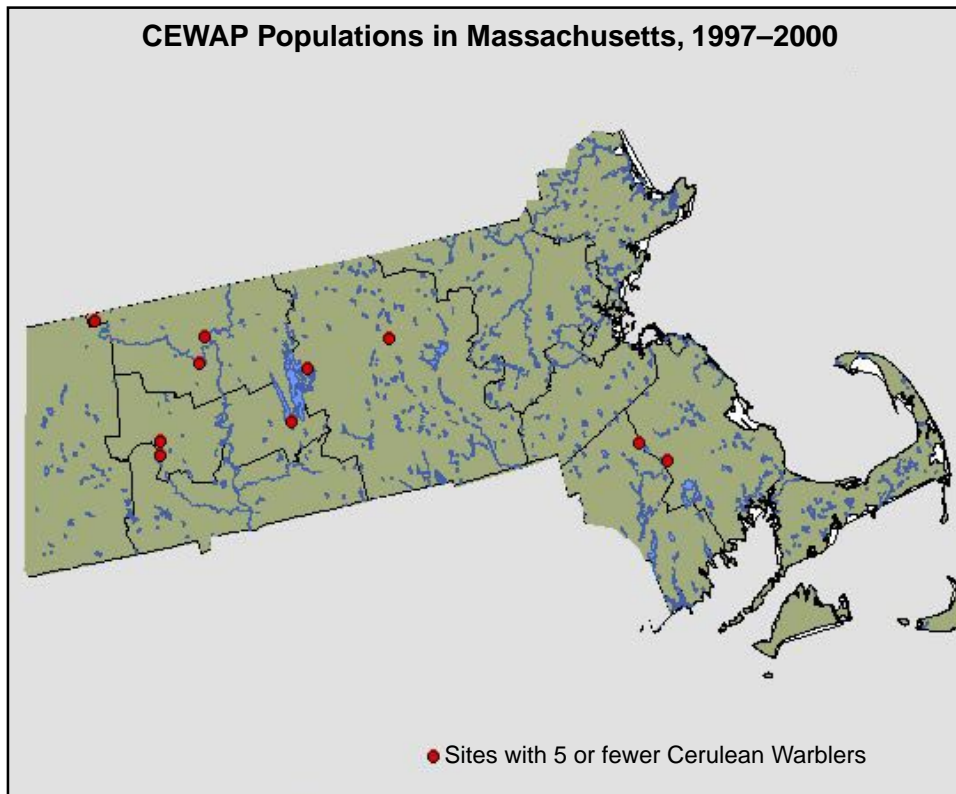
The Kentucky Breeding Bird Atlas (Palmer-Ball 1996) reports Cerulean Warblers from 16% of priority atlas blocks statewide. They were “fairly widespread” in the Cumberland Plateau and Mountains regions and “very locally distributed” over much of the remainder of the state. Hamel (2000) notes that the current status in Kentucky is very different from older accounts which state that this species was much more common and widespread.

This state received limited coverage from CEWAP participants. Most of our reports came from two sources: a point-count dataset from the Daniel Boone National Forest in eastern Kentucky (Linda Perry), and some additional surveys conducted through the KY Department of Fish and Wildlife Resources (Steve Thomas). Consequently, our atlas leaves large gaps, especially in the Cumberland Plateau region.

Data from Daniel Boone National Forest reveals a minimum of 71 birds from 96 point counts, primarily in

the Pioneer Weapons area, Wolf knob, Somerset and London Borea districts. We have no habitat data associated with these points. Other surveys reported an additional 67 Ceruleans from 20 sites, mostly state owned parks and management areas. The most birds found were 15 at Beech Creek WMA (Clay County), 7 birds each at Kentenia State Forest (Harlan County) and Fleming WMA (Fleming County), and 6 Ceruleans at Sloughs WMA (Union and Henderson Counties) (Map 13).

Of the latter 20 sites, 10 were dry slopes or ridges, accounting for 33 individuals, 3 sites were in moist cove forest with 8 birds, and 7 sites were in bottomland areas including swamp forest and lake margins, accounting for 28 Ceruleans. White oak, shagbark hickory, tulip tree, and maples were the most frequently reported trees at upland sites, whereas sycamore, sweetgum, red maple and elms were most frequent at bottomland sites.



Map 14. *Cerulean Warbler populations in Massachusetts. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.*

Massachusetts

Veit and Peterson (1993) estimated the total Massachusetts population of breeding Cerulean Warblers to be 5 to 10 pairs.

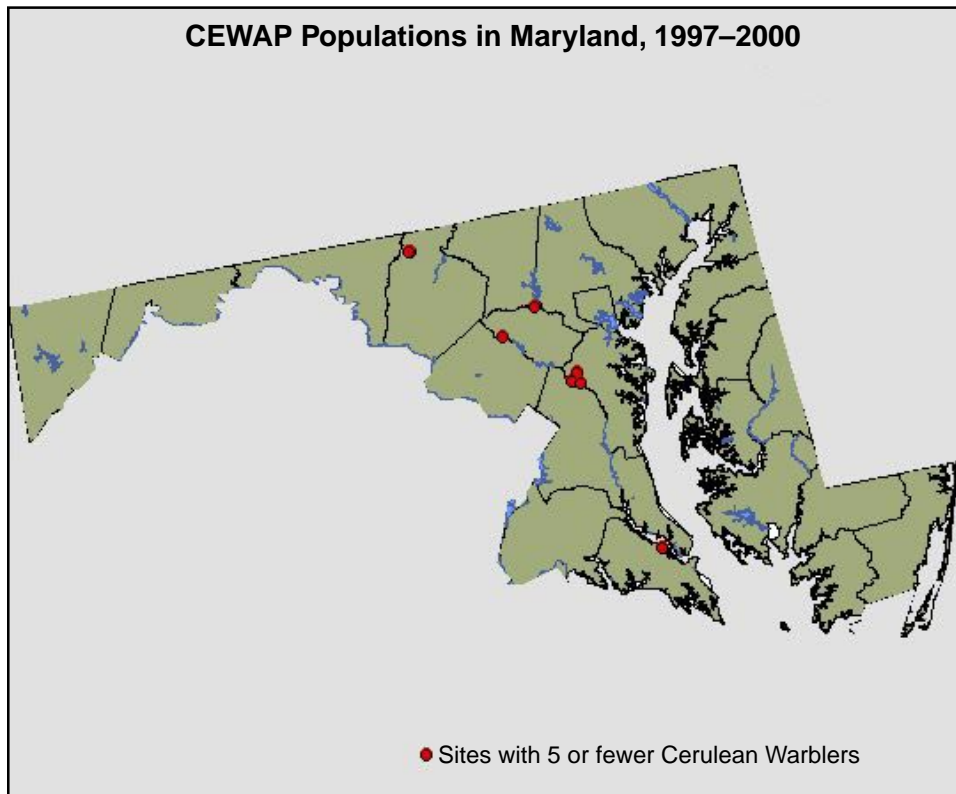
CEWAP participants documented 18 Ceruleans at 10 of 11 sites visited across the state, with several sites reporting 2 to 3 singing males present (Table 8). Areas with Ceruleans include several in the Connecticut River drainage in Franklin County, two sites along Quabbin Reservoir, and surprisingly, two sites in eastern Massa-

chusetts in Plymouth county (Map 14). About half of the birds found were in riparian or bottomland forest, and half in dry uplands.

Dominant tree species at occupied sites include oaks (red oak, white oak, northern red oak) and hickories in the uplands, red-maple swamp, and diverse riparian forests with cottonwood, willow, maples, oaks, birches, hemlock, and white pine.

Table 8. *Important areas for breeding Cerulean Warblers in Massachusetts.*

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
4	Quabbin Reservoir (West slope and Whitney Hill)	Hampshire, Worcester	Dry slope	750–800
3	Little Wachusett Mountain	Worcester	Dry slope	1279
3	Poets Seat—Greenfield	Franklin	Riparian	300
2	Stillwater—Deerfield	Franklin	Riparian	175
2	Middleboro	Plymouth	Swamp forest	50
2	Knightville Dam	Hampshire	Mesic forest	610–787
1	Dunbar Valley, Monroe State Forest, Rowe	Franklin	Riparian	1500
1	Erwin S. Wilder WMA	??	Dry slope	??



Map 15. *Cerulean Warbler* populations in Maryland. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

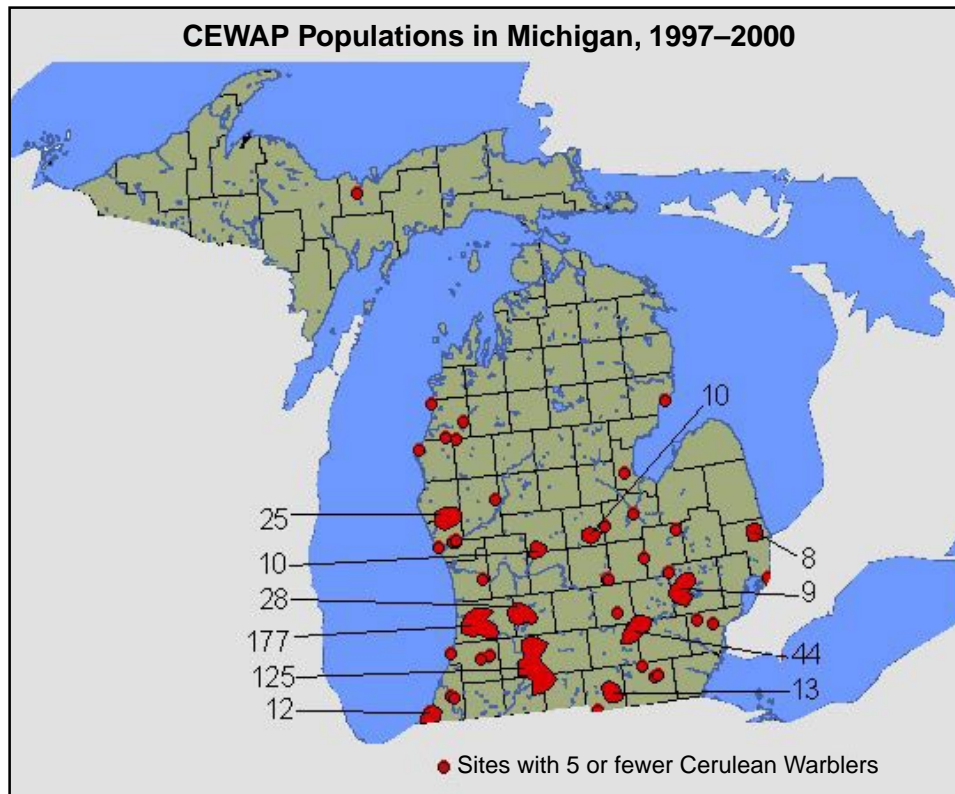
Maryland

Robbins and Blom (1996) report Cerulean Warblers at 165 out of 1,256 possible Breeding Bird Atlas blocks. The species was most common and widespread in the narrow ridge and valley of western Maryland, including Catoclin Mountain area, and locally distributed along rivers flowing down through the Piedmont.

CEWAP surveys yielded only 16 Ceruleans on 9 (82%) of 11 sites surveyed. Nine (56%) of the 16 observations came from Howard County in the central part of the state (along Patuxent and Patapsco Rivers) and four observations came from the Big and Little Patuxent Rivers in Anne Arundel and Prince Georges counties

(Map 15). Two individuals were noted at Catoclin Mountain Park in Frederick County, and an anomalous bird was at Greenwell State Park near the mouth of the Patuxent River in St. Mary's County. The lack of surveys conducted in the ridge and valley of western Maryland, where this species is undoubtedly quite common, represents one of the largest gaps in this rangewide atlas.

All but the Catoclin birds were in riparian forests dominated by sycamore, tulip tree, and silver maple. The upland birds were in sugar maple-basswood forest.



Map 16. *Cerulean Warbler* populations in Michigan. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Michigan

The *Atlas of Breeding Birds of Michigan* (Brewer, et al. 1991) reports Cerulean Warblers from 155 (8.2%) of 1,896 townships, with 143 (92%) of these observations coming from the southern Lower Peninsula.

CEWAP surveys yielded a total 507 birds at 176 (96%) of 183 sites (Map 16). Two sites in Allegan County, the Allegan State Game Area and Kalamazoo River, accounted for 177 (35%) of the 507 birds observed (Table 9). Other important areas included Fort Custer in Kalamazoo and Calhoun counties, and the

Waterloo Recreation Area in Washtenaw and Jackson counties.

Sites containing dry upland forest and riparian/swamp forest accounted for 185 (36%) and 150 (30%) cerulean observations, respectively. These two habitat types were present at 149 (85%) of 175 sites where habitat conditions were reported (Figure 14).

Of 129 sites where tree species were reported, 99 (78%) contained oaks and 51 (39%) contained maples. Other commonly reported tree species included hicko-

Table 9. *Important areas for breeding Cerulean Warblers in Michigan.*

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
177	Allegan State Game Area and Kalamazoo River	Allegan	Riparian, swamp forest, mesic forest	600–700
100	Fort Custer and vicinity	Kalamazoo, Calhoun	Dry upland forest	820–1010
44	Waterloo Recreation Area	Washtenaw, Jackson	Dry upland forest	984–1050
24	White River	Muskegan, Oceana	Riparian	600
21	St. Joseph River	Branch, St. Joseph	Riparian	853–886
10	Perry Trust	Barry	Mesic Forest	951
10	Flat River State Game Area	Montcalm	Dry upland forest	820

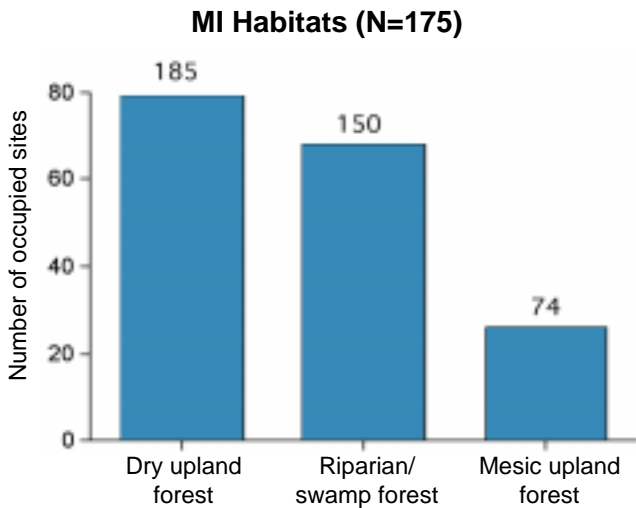


Figure 14. Habitat classifications at sites with Cerulean Warblers in Michigan. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

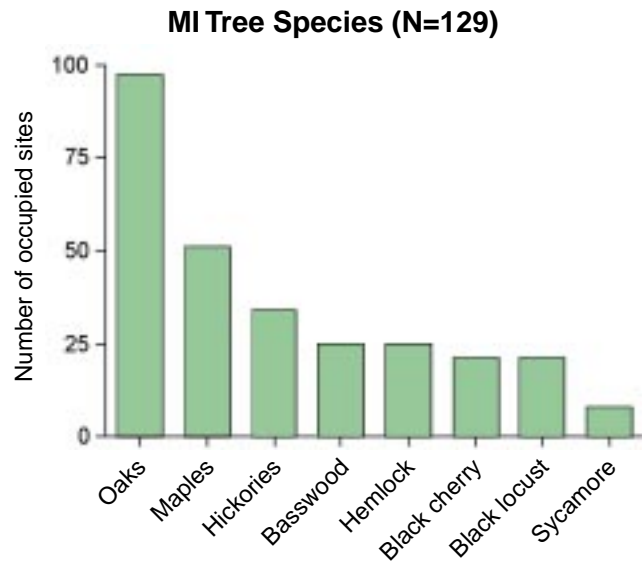


Figure 15. Predominant tree species reported at occupied sites in Michigan. “N” equals number of sites with tree species reported by CEWAP participants.

ries, America basswood, eastern hemlock, black cherry, and black locust (Figure 15). For the 117 sites where tree species data were reported, the most frequently ob-

served species included oaks (black oak, red oak, and swamp white oak), maples (silver maple, sugar maple and red maple) and willow species.

Minnesota

Citing a personal communication from Steve Stucker and Richard Baker of the Minnesota County Biological Survey, Hamel (2000) reports that “Since 1988, the Minnesota County Biological Survey has surveyed 22 counties within the range of the Cerulean Warbler. As a result of this effort, singing males were observed at 103 ‘locations’ (or element occurrences) which can be grouped into 42 ‘local populations.’ These consist of 8 local populations in floodplain forest and 34 local populations in upland forest. Seven of the 8 largest local popu-

lations were in upland forest.”

CEWAP participants discovered 103 Cerulean Warblers at 57 sites in south-central Minnesota (Map 17). At least one individual cerulean was noted at each of the 57 sites surveyed (Table 10). Sites with greater than 10 Cerulean Warblers included Murphy-Hanrehan Reserve and County Park in Scott County, Lake Maria State Park in Wright County, and Stanley Eddy County Park in Wright County. Besides the cluster of sites in northern Wright County, a majority of birds were found near

Table 10. Important areas for breeding Cerulean Warblers in Minnesota.

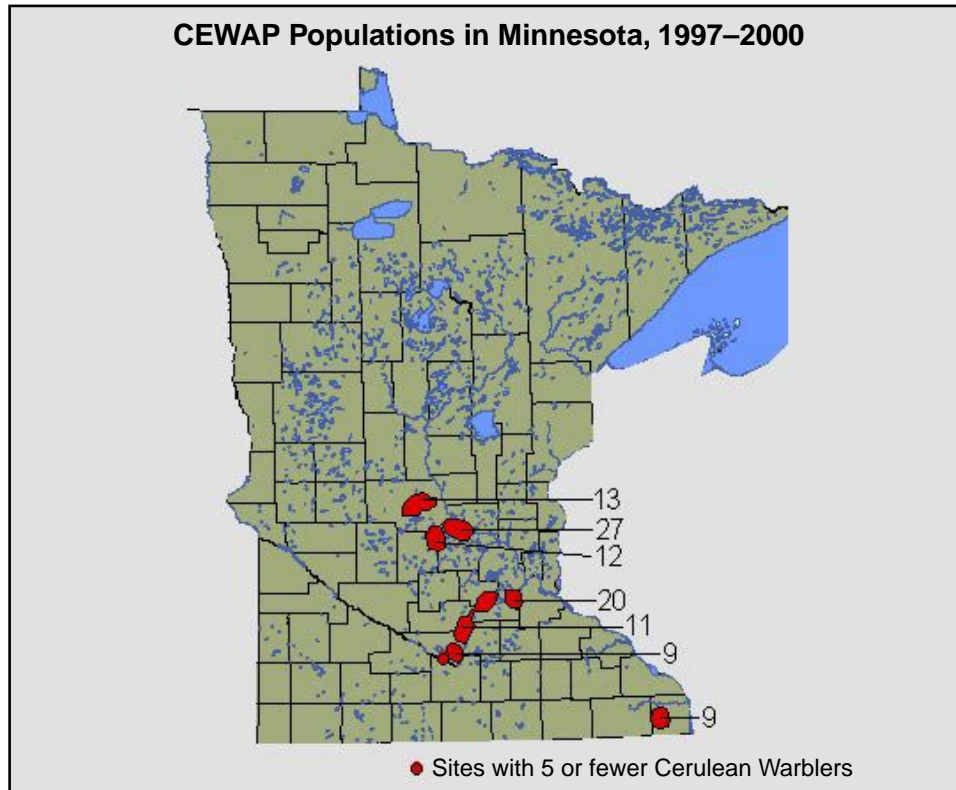
Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
20	Murphy-Hanrehan Park Reserve and County Park	Scott	Riparian, mesic slope	1000
16	Lake Maria State Park	Wright	Riparian, dry slope	??
11	Stanley Eddy County Park	Wright	Dry slope	??
9	Beaver Creek Valley State Park	Houston	Riparian, mesic slope	752
9	Seven Mile Creek County Park	Nicollet	Riparian, dry slope	??
7	Kelly Lake, MN Valley Recreation Area	Carver, Scott	Riparian	??
8	St. Johns Woods	Stearns	Riparian, dry slope	??
5	Suconnix WMA	Wright	Riparian	??
5	Harry Larson County Park	Wright	Riparian	??

the Minnesota River in Scott, Carver, and Nicollet Counties. An outlying population was at Beaver Creek Valley State Park in the southeast corner of the state. At this point, we do not know how these sites compare with the Minnesota Biological Survey database.

Of 39 sites reporting habitat conditions, 20 (51%) were classified as riparian, while 17 (44%) were in dry slope conditions. Of the 79 birds observed at these 39

sites, 41 (51%) were noted in riparian and 23 were in dry slope habitats (Figure 16).

Oaks, maples, and American basswood were the most commonly reported tree species in Minnesota (Figure 17). At upland sites, red oak, bur oak, sugar maple, and basswood were most frequently reported, whereas at riparian sites cottonwood, silver maple, red oak, ash, and elm were dominant species.



Map 17. Cerulean Warbler populations in Minnesota. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

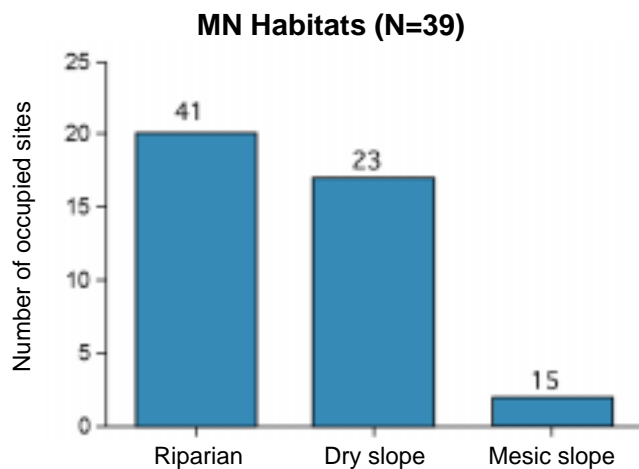


Figure 16. Habitat classifications at sites with Cerulean Warblers in Minnesota. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

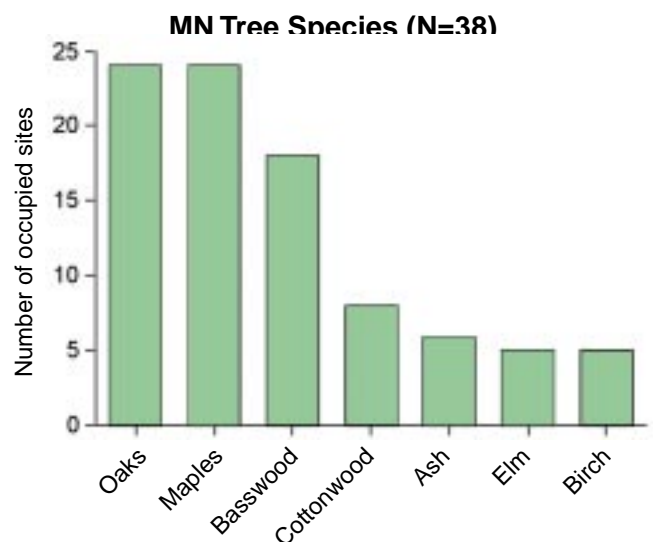


Figure 17. Predominant tree species reported at occupied sites in Minnesota. “N” equals number of sites with tree species reported by CEWAP participants.

Missouri

The *Missouri Breeding Bird Atlas* (Jacobs and Wilson 1997) reported Cerulean Warblers from 81 (7%) of 1,207 atlas blocks statewide. Hamel (2000) states: “Some Missouri occurrences in uplands, but the major numbers are associated with riparian corridors and other areas near rivers, particularly the Current, Jack’s Fork, and Eleven Point rivers in the Ozarks in southeastern Missouri.” CEWAP coverage in Missouri was confined to the southeastern portion of the state within these several major riparian areas. Note the lack of surveys from the Ozarks of southwestern Missouri; given the large number of birds found in northwestern Arkansas, we expect that similarly large populations may exist in that part of Missouri as well.

Almost all of the southern half of Missouri was originally, and is again today, blanketed by oak-hickory and oak-pine forests. In 1998 Jane Fitzgerald hired Tim Kippenberger and Tom Hall to survey several rivers in this Ozark region. Tim and Tom’s canoe surveys of the Black River, Courtois Creek, Eleven Point River, and Huzzah River revealed densities of over 4.5 singing males per river mile. Mark Robbins (an ornithologist from the University of Kansas) who worked in conjunction with Tim and Tom discovered densities of 3.5 singing males per river mile when floating the Upper Current River. However, there were still distinct stretches of river where warblers were not present.

Stretches of the Eleven Point River were digitized in the fall of 1999 and entered into a GIS database at the

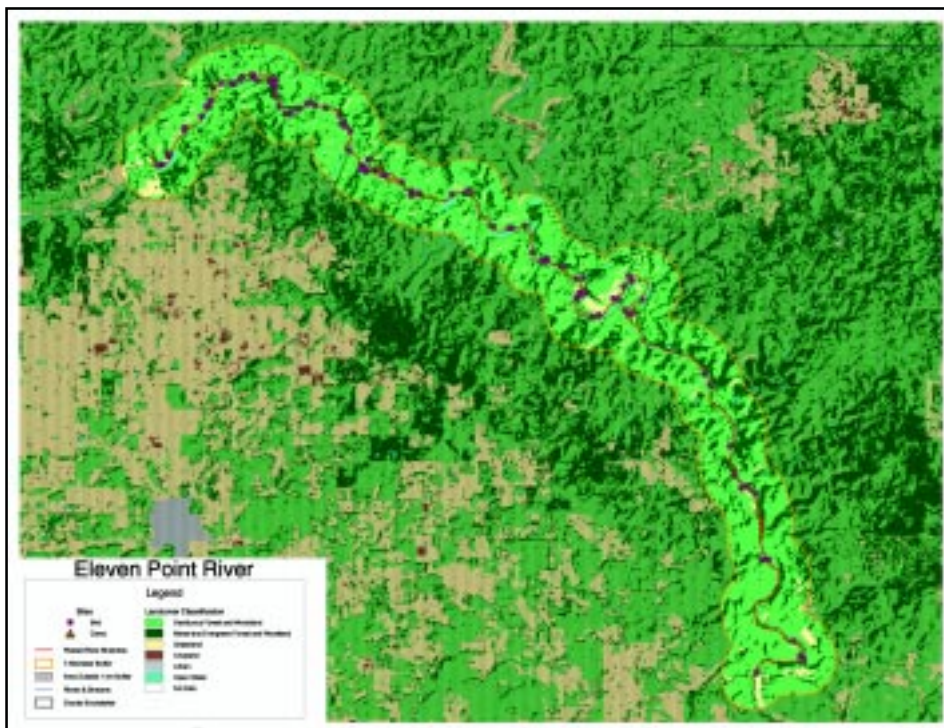
Missouri Department of Conservation. Information on warbler distributions were then superimposed upon a map of land cover (i.e. the amount and distribution of cover types such as forest, pasture, urban areas, etc.) within a 7-mile distance on either side of the area of river in question (Map 18).

We were told that the maps would be updated sometime in 2000. An analysis will be run to determine the significance of relationships among landscape variables (e.g. percent of forest in the landscape, patterns of forest fragmentation, etc.) and warbler distributions. Results of the analyses will help us to better understand what geographic scale we need to consider as we attempt to conserve this high priority species in MO

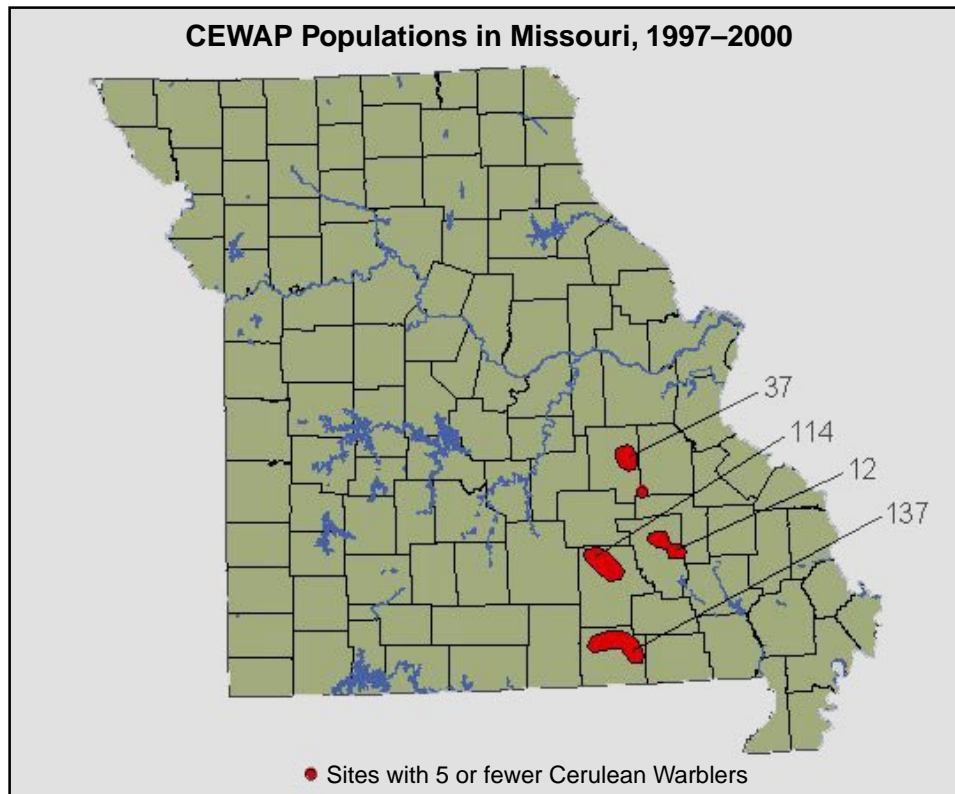
CEWAP participants in Missouri tallied 301 ceruleans at 31 (97%) of 32 sites surveyed (Map 19). The two most important areas were the Eleven Point River with 137 (45%) birds and the Upper Current River with 114 (38%) birds (Table 11).

Twenty-three (74%) of the 31 sites with Ceruleans were classified as riparian. Not surprisingly, these riparian sites accounted for 286 (95%) of the total number of observations (Figure 18).

Commonly reported tree species at occupied sites included sycamore, oaks, and maples. Other trees reported included American walnut, pines, birches, American elm, and willows (Figure 19). Mature sycamore forest is clearly the most important habitat for Cerulean Warblers along river systems in Missouri.



Map 18. The distribution of singing male Cerulean Warblers along the Eleven Point River, outlining the 1-kilometer zone where land cover is being mapped.



Map 19. Cerulean Warbler populations in Missouri. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 11. Important areas for breeding Cerulean Warblers in Missouri.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
137	Eleven Point River	Oregon	Riparian	495–670
114	Upper Current River	??	Riparian	??
34	Curtois Creek	Crawford	Riparian	640–680
12	Black River	Reynolds	Riparian	570

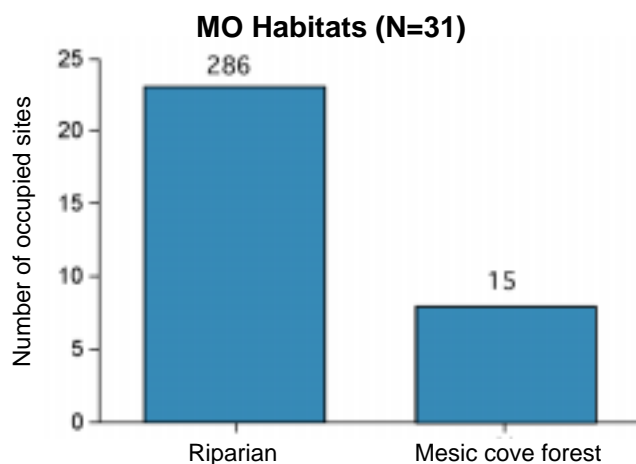


Figure 18. Habitat classifications at sites with Cerulean Warblers in Missouri. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

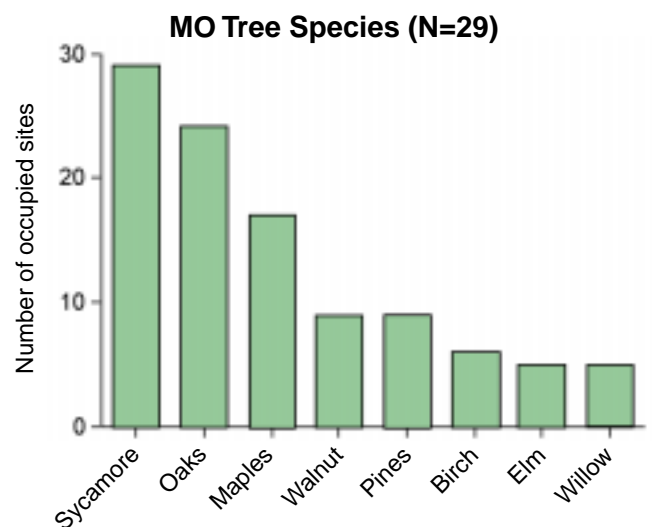


Figure 19. Predominant tree species reported at occupied sites in Missouri. “N” equals number of sites with tree species reported by CEWAP participants.

Nebraska

CEWAP participants surveyed 1 site at the Fontenelle Forest in Sarpy County, where they noted 1 Cerulean

Warbler. This site was in a riparian forest along the Missouri River dominated by bur oak and hickory.

New Jersey

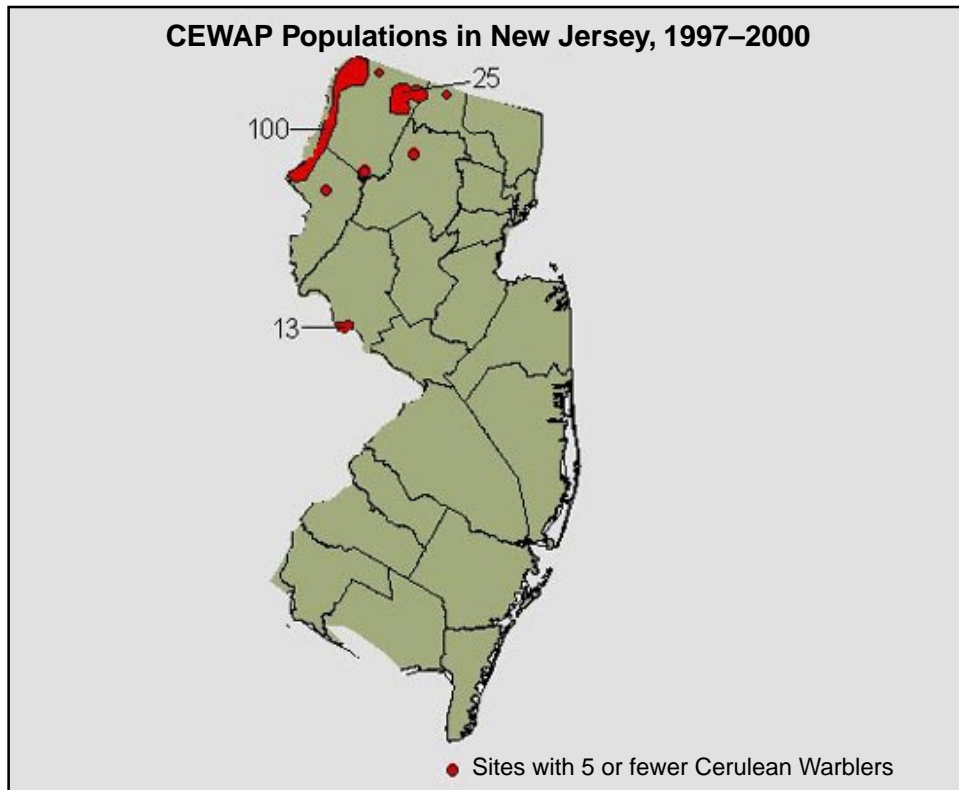
In New Jersey, the majority of our data came from John Benzinger, who conducted CEWAP surveys in 1999, and Dennis Miranda of the NJ Conservation foundation. In addition, Benzinger conducted surveys for the NJ Endangered Species and Nongame Program of the Division of Fish and Wildlife, and we gratefully acknowledge Amanda Dey for sharing results of these earlier surveys. Their quantitative assessments do not strictly follow CEWAP protocols, but provide a similar picture of habitat use in this region. Much of the following account is from Miranda (in litt. and pers. comm.) and from Benzinger's reports to the state agency.

In recent years, the Cerulean Warbler is a common breeder along the Delaware River, which divides this State from Pennsylvania (Map 20). From the Delaware Gap north to Port Jervis, NY, the Cerulean Warbler is found along the riparian corridor of the Delaware River. The birds tend to use mature deciduous stands of oaks, tulip poplar and sycamores as their prime habitat. The density of Cerulean Warbler along the Delaware River is impressive, with singing males found within several hundred feet of each other.

An extension of the Delaware River population has colonized the Stokes State Forest, High Point State Park, the Flatbrook-Roy Wildlife Management Area, and the Walpack Wildlife Management Area. Often the Cerulean Warblers carve their territories adjacent to or in the vicinity of lakes such as Sawmill Lake at High Point State Park and ponds created by beaver activity. Despite the presence of extensive forests, the Cerulean Warbler has a lower density in these highlands than in the Delaware River corridor.

The Cerulean Warbler also occurs in isolated spots in forested dry ridgetops, often associated with a forest openings. This habitat preference is infrequently used, with occurrences usually consisting of 2–3 singing males in close proximity of each other, but more scattered from each other than habitat used along riparian corridors. Site fidelity is questionable since an occupied site may be used one or two years and then go unused in subsequent years.

In the Highlands physiographic province of New Jersey, the Cerulean Warbler has always been an uncommon breeder along small rivers and streams and to a



Map 20. Cerulean Warbler populations in New Jersey. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

lesser extent on dry ridgetops. Small colonies composed of 2–3 singing males were the most common encounter. Some sites like Dunker Pond in the Newark Watershed and the Rockaway River in the Jersey City Watershed held small colonies for years during the 1980s. Today, the Cerulean Warbler is fast disappearing as a breeder in the Highlands despite plenty of extensive forests, with patch sizes up to 6,000 acres. The increased rarity results in occurrences limited to single birds or pairs in isolated areas and far from other known breeding sites. The Cerulean Warbler has the greatest concentration in the Highlands on Hamburg Mountain ridge of Vernon and Hardyston townships. Occurring in dry ridgetops near small lakes and ponds and along small streams, the Cerulean Warbler is found in locally dense colonies; sometimes 5–6 pairs can be found in a 1/2 mile stretch of stream or woods road. They are found in small openings of the canopy or in dense stands of primarily deciduous trees such as maples, tulip poplars, and oaks. The greatest concentrations occurs in the more remote areas of Hamburg Mountain far from forest edges and seemingly preferring deep forest interiors. An estimated 25–30 pairs can be found on Hamburg Mountain.

Additional surveys in the northern Highlands region by Benzinger and Miranda specifically targeted previously known sites and documented their recent disappearance or rarity. Locations of former occurrence include Ringwood State Park, Greenwood Lake, Canistear Reservoir, Dunker Pond, and Saffin Pond. Areas further east, especially adjacent to the Sterling Forest on the NY border, need to be more thoroughly searched in the near future.

South of the Delaware Water Gap and Northern Highlands, Cerulean Warblers occur in a few, isolated small populations. Most notable of these are the birds at Bulls Island State Park, which occupy mature sycamore forest in the Delaware River. Small numbers were also found in the vicinity of Jenny Jump and Allamuchy Mountain State forests, including along Shades of Death Rd. (Warren Co.) and the Pequest River near Tranquility (Table 12).

Benzinger noted the overall bimodal distribution of Cerulean Warbler habitats in New Jersey, as in other northeastern states. Roughly half of all individuals found were associated with strips of riparian forest along the Delaware river, Big Flatbrook Creek, or other major tributaries (Figure 20). Although CEWAP tree data were not provided from specific sites, these riparian forests are dominated by mature American sycamores. The other habitat most frequently used was upland forest on slopes and ridgetops, dominated either by mesic mixed oak forest or drier oak-hickory forests. As elsewhere in the region, various oaks (especially red oak and white oak), maples (especially red maple), white ash, and tulip tree are dominant trees at occupied sites. It is likely that high numbers of Ceruleans in the uplands of the Kittatinny Mountains results from their close proximity to the Delaware River—similar upland and streamside habitats farther east are unoccupied.

Benzinger further notes the propensity for Cerulean Warblers to occur at or near forest edges, especially near ponds, swamps, or at the border between a forested slope and non-forested river valley. Along the Delaware River, birds were sometimes observed in open-canopied

Table 12. Important areas for breeding Cerulean Warblers in New Jersey.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
40	High Point State Park, Stokes State Forest	Sussex	Dry ridgetop, upland forest	1300–1500
30	Worthington State Forest to Millbrook (Del. Water Gap)	Warren	Riparian, mesic slope	100–500
25–30	Hamburg Mountain and vicinity	Sussex	Dry slope, lake margin	1300–1500
20	Delaware River—Old Mine Rd.	Sussex	Riparian, mesic slope	200–500
12	Bull’s Island State Park	Hunterdon	Riparian, river island	75-100
10	Wallpack WMA, Big Flatbrook Creek	Sussex	Riparian, mesic slope	200–500
5	Jenny Jump State Forest, Shades of Death Rd.	Warren	Upland forest	??
3	Pequest River, Tranquility	Warren	Riparian	850
2	Wanaque Wildlife Management Area	Passaic	Upland forest	1300
5	Allamuchy Mountain State Park	Warren, Sussex	Upland forest	900–1000
5	Wawayanda State Park	Sussex	Upland forest	1100–1500

patches, the apparent sites of abandoned homesteads or farms. Furthermore, several occupied areas along the Delaware represented forest strips within grassland or shrubland habitat, suggesting that structure of the forest canopy was more important than extent of habitat patches in this region. Virtually all occupied sites were in forest with canopy height > 15m.

At present, the vast majority of Cerulean Warblers in NJ are on public lands, both state and federally owned. Although these areas are under protection from largescale disturbance, specific management guidelines for Cerulean Warblers do not exist, and important habitats (e.g. strips of riparian forest) are potentially vulnerable to recreational development. An important exception is in the Northern Highlands region, where most birds occur on private land. In particular, the largest remaining population on Hamburg Mountain is currently threatened by development (Miranda).

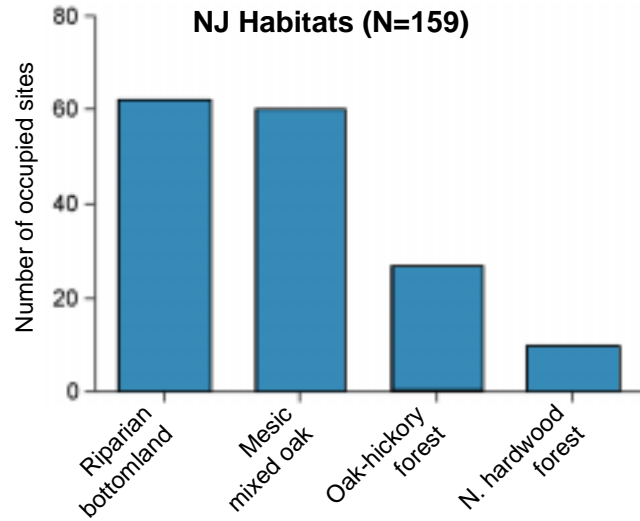


Figure 20. Habitat classifications at sites with Cerulean Warblers in New Jersey. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

New York

The *Atlas of Breeding Birds in New York State* (Andrle and Carrol 1988) reported Cerulean Warblers from 279 (5%) atlas blocks statewide. The bulk of the distribution was reported from the Lake Ontario Plain, with scattered populations south into the Finger Lakes, along the Southern Tier, and in the Hudson Valley and Highlands. Andrle and Carrol, as well as Bull (1974) discuss the separate expansions of Cerulean Warblers into New York from the Great Lakes to the west, and from New Jersey and Pennsylvania to the south.

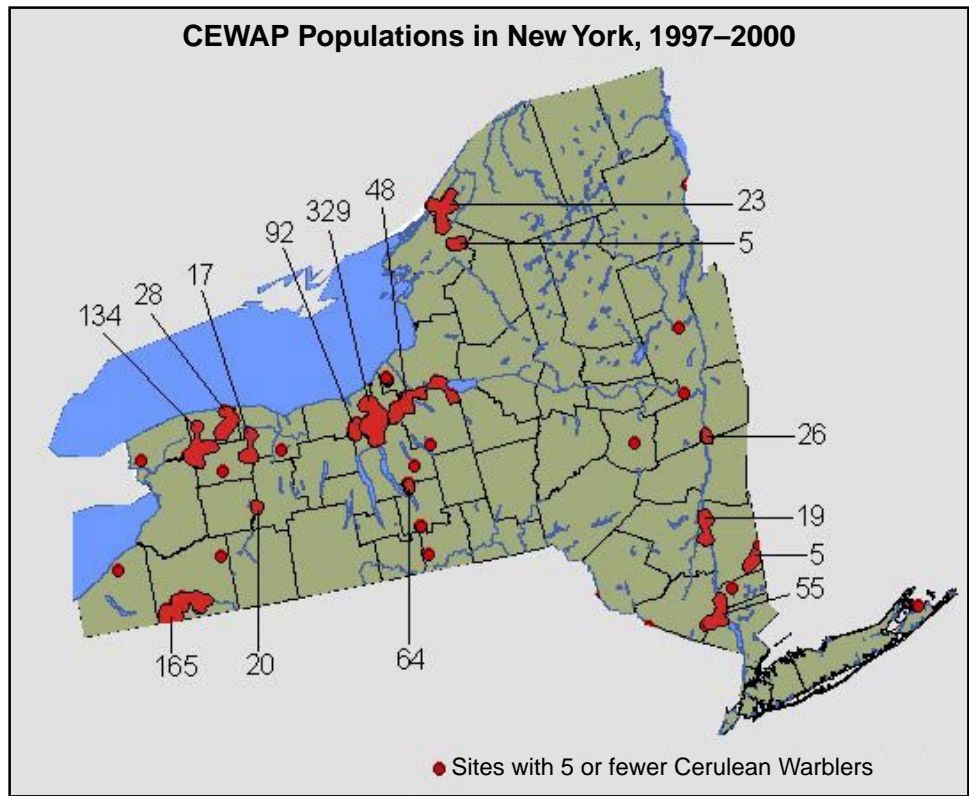
CEWAP participants documented 1,086 Cerulean Warblers at 246 (86%) of 286 sites surveyed in New York State (Map 21). Several areas proved to be important; however, four stand out because of exceptional numbers of birds. These include: the Montezuma National Wildlife Refuge in Wayne, Seneca, and Cayuga counties; the Alleghany River-Salamanca region in Cattaraugus County; the Galen Wildlife Management Area in Wayne County; and the Iroquois National Wildlife Refuge/Orchard Oak Wildlife Management Area in Genesee and Orleans counties. Combined, these four areas accounted for 626 (58%) of the Cerulean Warblers counted in the state (Table 13). Other important areas included several sites in the Hudson Highlands of southeastern New York and Salmon Creek near Cayuga Lake.

Of 240 sites where habitat data were reported, 184 (77%) were classified as bottomland/riparian. These bottomland/riparian sites accounted for 773 (74%) of the Cerulean Warblers observed. Forty-six sites were classified as dry slopes, accounting for 222 (21%) cerulean observations (Figure 21).

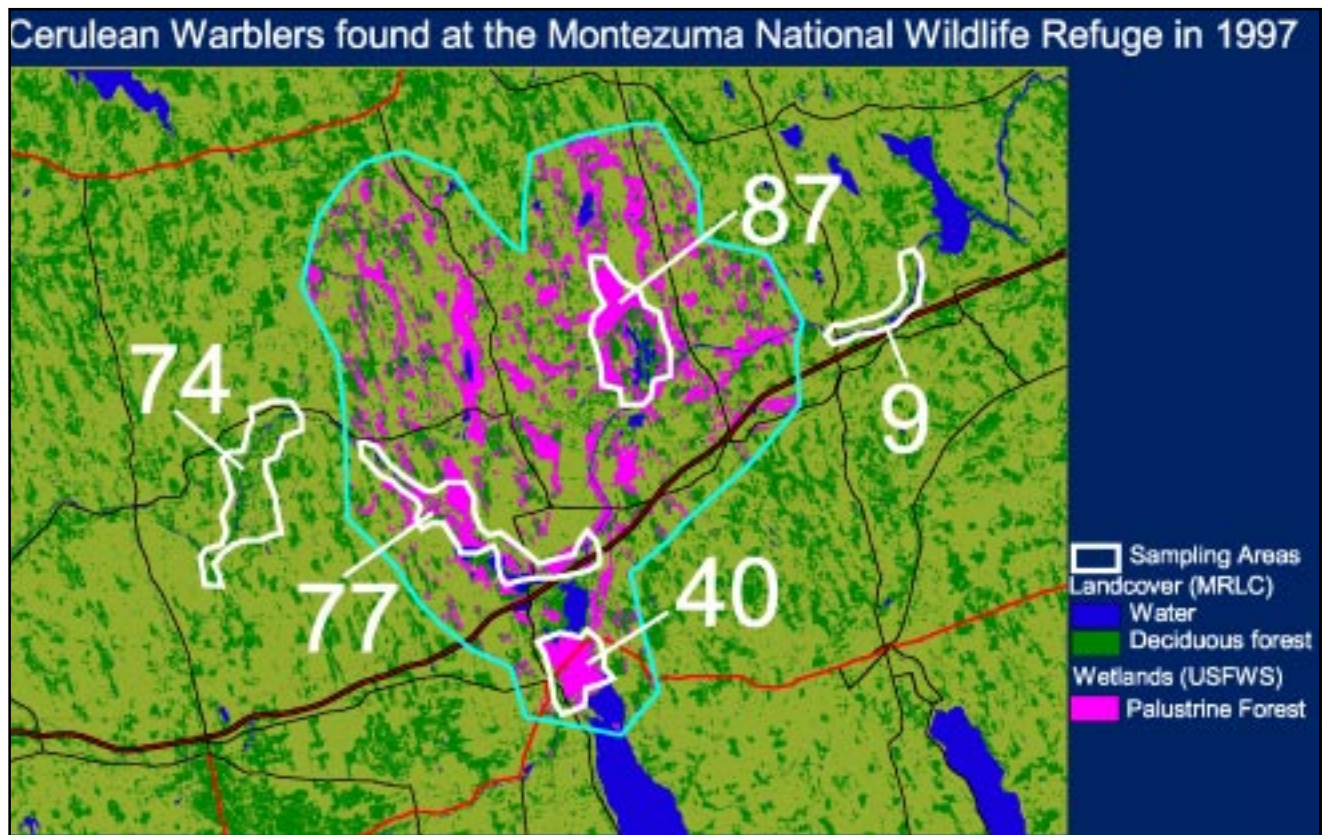
For 215 sites reporting tree species, the most commonly reported trees included maples, cottonwood, and oaks. Other important tree species at occupied sites included ash, American basswood, hickories, American beech, black locust, and sycamore (Figure 22). In a breakdown by region of the state, bottomland sites in the Montezuma and Iroquois region were dominated by cottonwood, silver and red maple, sycamore, and green ash. Sites in the Hudson Highlands were primarily white oak, American beech, sycamore, and ash, whereas sites along the Hudson River were predominantly cottonwood and sycamore. Sites in the Alleghany region were dominated by white oak, red oak, chestnut oak, sugar maple, black cherry, and white ash. Cerulean habitat along Salmon Creek in Tompkins County consisted of a diverse forest with sycamores, cottonwood, and black locust in the floodplain and red oak, basswood, and maples on the surrounding slopes.

Most of the Cerulean Warblers in New York occur on publicly owned lands, with the largest populations on National Wildlife Refuges, State Parks, and State Wildlife Management Areas. An important exception is the Salmon Creek population, which exists entirely on private lands. Following initial CEWAP surveys; however, the local Finger Lakes Land Trust became interested in this site and has subsequently acquired several sections of prime Cerulean habitat from willing sellers. The National Audubon Society of New York contributed to the conservation of this site by designating it an Important Bird Area and providing support to the Land Trust. Nearly every site with breeding Cerulean War-

(Continued on page 34)



Map 21. Cerulean Warbler populations in New York. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.



Map 22. Cerulean Warbler populations at Montezuma National Wildlife Refuge.

blers in New York State has been designated as an Important Bird Area (Wells 1998).

Montezuma Wetlands Complex. Probably the most complete surveys were conducted on and near the Montezuma National Wildlife Refuge in central NY (Map 22). Bill Evans surveyed most natural and artificial waterways by canoe, sampling a majority of the taller forested wetlands in the region. The 420± males found were concentrated largely in four areas, three of which lie within the USFWS acquisition area for the

Montezuma wetlands complex (outlined in light blue on Map 4). The largest number (87 males) was found at Howland Island Wildlife Management Area, 77 males were found in a band from Mays Point Pool area westward, and 40 birds were in the Mud Lock area south of Rt. 20 and around Montezuma NWR headquarters. Note that the westernmost site, with 74 Ceruleans, is the Galen Wildlife Management Area, a state owned tract of similar habitat along the Clyde River. A few additional birds were found eastward along the Seneca River.

Table 13. Important areas for breeding Cerulean Warblers in New York.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
325	Montezuma wetlands complex	Wayne, Seneca, Cayuga	Bottomland, riparian	??
116	Alleghany River-Salamanca region	Cattaraugus	Riparian, dry slope	1350–2200
95	Galen Wildlife Management Area	Wayne	Riparian	??
90	Iroquois NWR, Oak Orchard WMA, and vicinity	Genesee, Orleans	Riparian, swamp forest	630
63	Salmon Creek	Tompkins	Riparian, mesic slope	??
51	Alleghany State Park and vicinity	Cattaraugus	Dry slope	1400–2000
48	Tonawanda Indian Reservation,	Genesee	Riparian, swamp forest	650
33	Bear Mountain State Park	Rockland	Dry slope, bottomland	300–1000
26	Castleton Island State Park	Rensselaer, Greene	Riparian, river island	10
20	Letchworth State Park	Livingston	Riparian	??
20	West Point Military Reservation	Orange	??	??
19	Murray-Hulberton Area	Orleans	Riparian, swamp forest	395
15	Chittenango Creek	Onandaga, Madison	Riparian, swamp forest	385

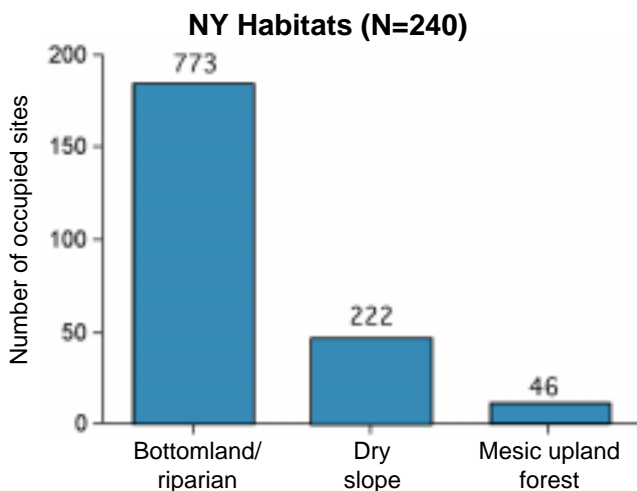


Figure 21. Habitat classifications at sites with Cerulean Warblers in New York. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

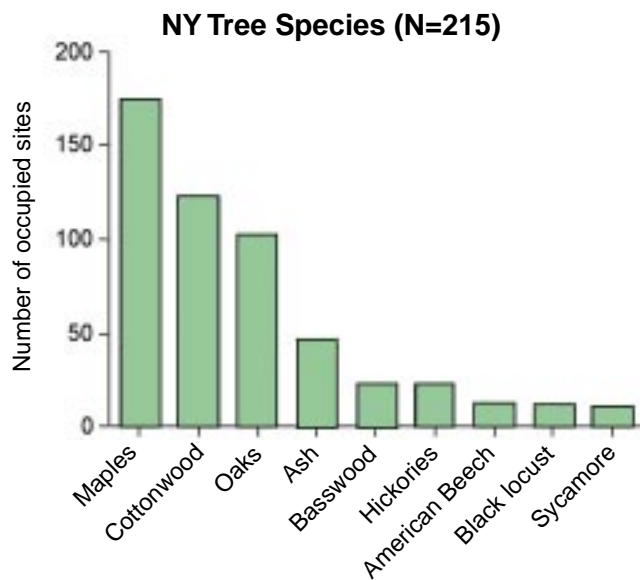


Figure 22. Predominant tree species reported at occupied sites in New York. “N” equals number of sites with tree species reported by CEWAP participants.

Observations of singing birds at Montezuma NWR (N = 235) showed heavy use of red and silver maples (44%), cottonwoods (28%), and ash (16%) (Figure 23).

Concentrations of Cerulean Warblers were all within contiguous blocks of palustrine forest dominated by maples and cottonwoods (shown in magenta within the acquisition area on Map 4). These forests exist primarily along canals and natural channels of the Clyde and Seneca rivers and are often inaccessible except by boat. Areas with many Ceruleans often consisted of unusually large trees, including emergent cottonwoods and swamp white oaks reaching 30 to 40 m in height. Some of these trees undoubtedly date back to the period of barge canal construction in the early 1800s. Average estimated height of trees with singing Ceruleans was 28.3 m (N = 145 trees). Some areas with Ceruleans were in younger forests (especially red maple swamps), but these tended to be adjacent to areas with taller trees. Additional tracts of seemingly suitable habitat, most notably in the Carusoe Lake area, were surveyed but turned up few or no Ceruleans.

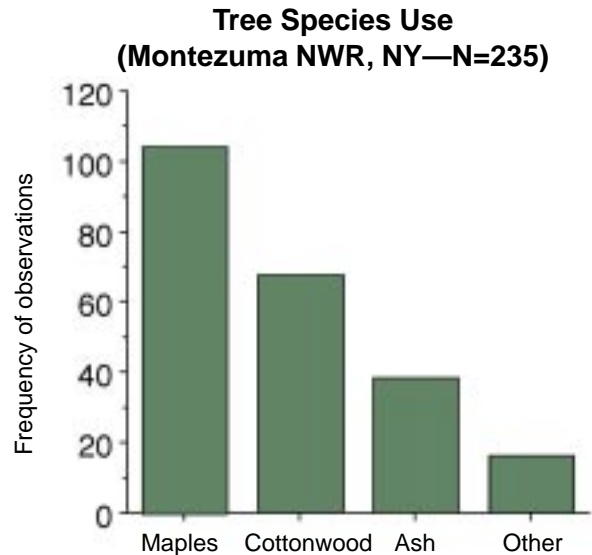
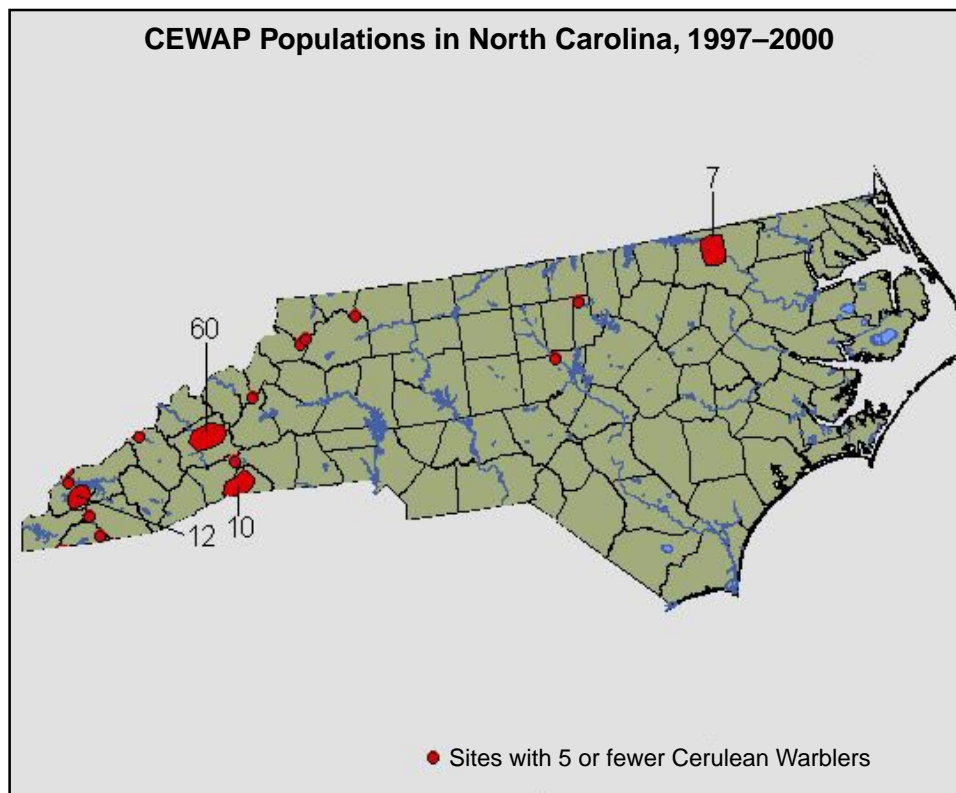


Figure 23. Tree species used by singing Cerulean Warblers in the Montezuma wetlands complex, central NY.

North Carolina

LeGrand (1979) indicates that ceruleans are “rare” and “local summer residents” at lower elevations in mountains and along the Roanoke River in the coastal plain.

CEWAP surveys yielded 109 birds at 39 (93%) of 42 sites (Map 23). By far, the most important site was along the Blue Ridge Parkway in Buncombe County, where 60 (55%) Ceruleans were noted (Table 14). Additional



Map 23. Cerulean Warbler populations in North Carolina. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

birds were located at other points along the Blue Ridge Parkway, on the Cheoah Ranger District of Nantahal National Forest, and on White Oak and Warrior Mountains in Polk County. Only 3 birds were located in Great Smoky Mountains National Park. Finally, recent surveys along the Roanoke River revealed 7 Cerulean Warblers.

Of 27 sites reporting habitat data, 13 (50%) were classified as dry slope, while 9 (33%) were in riparian ar-

reas. Of the 75 Ceruleans reported from these 27 sites, 53 (71%) were in dry slope habitats, and 11 birds each were in riparian and cove forest habitats (Figure 24).

Upland sites along the Blue Ridge were dominated by oaks (white oak, scarlet oak, chestnut oak), hickories, and tulip tree, whereas riparian forests where Ceruleans occur along the Roanoke River were dominated by sycamore, cottonwood, and green ash (Figure 25).

Table 14. Important areas for breeding Cerulean Warblers in North Carolina.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
60	Blue Ridge Parkway, Pisgah National Forest	Buncombe	Dry slope, moist cove forest	3100–3700
10	Cheoah Ranger District, Nantahal National Forest	Graham	Dry slope, moist cove forest	??
10	White Oak and Warrior Mountains	Polk	??	2000–2400
7	Roanoke River	Halifax, Northampton	Riparian	50
4	Flat River Bluffs	Durham	Riparian	500
3	Blue Ridge Parkway	Ashe	Cove forest	3200
3	Nantahal Lake, Nantahal National Forest	Macon	??	??
3	Great Smoky Mountains National Park	Swain, Haywood	??	??
2	Stecoah Gap, Nantahola NF	Graham	Dry slope	3165
2	Chunky Gal Mountain	Clay	??	3400–3800
2	Doughton, U.S. 21	Wilkes	??	??
2	Chimney Rock Park	Rutherford	??	??

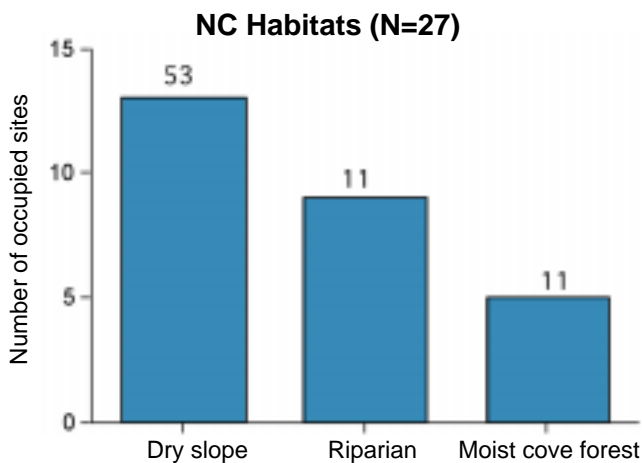


Figure 24. Habitat classifications at sites with Cerulean Warblers in North Carolina. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

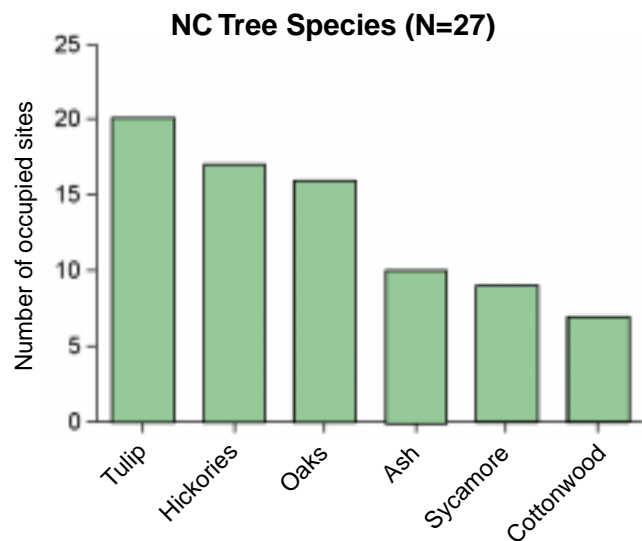


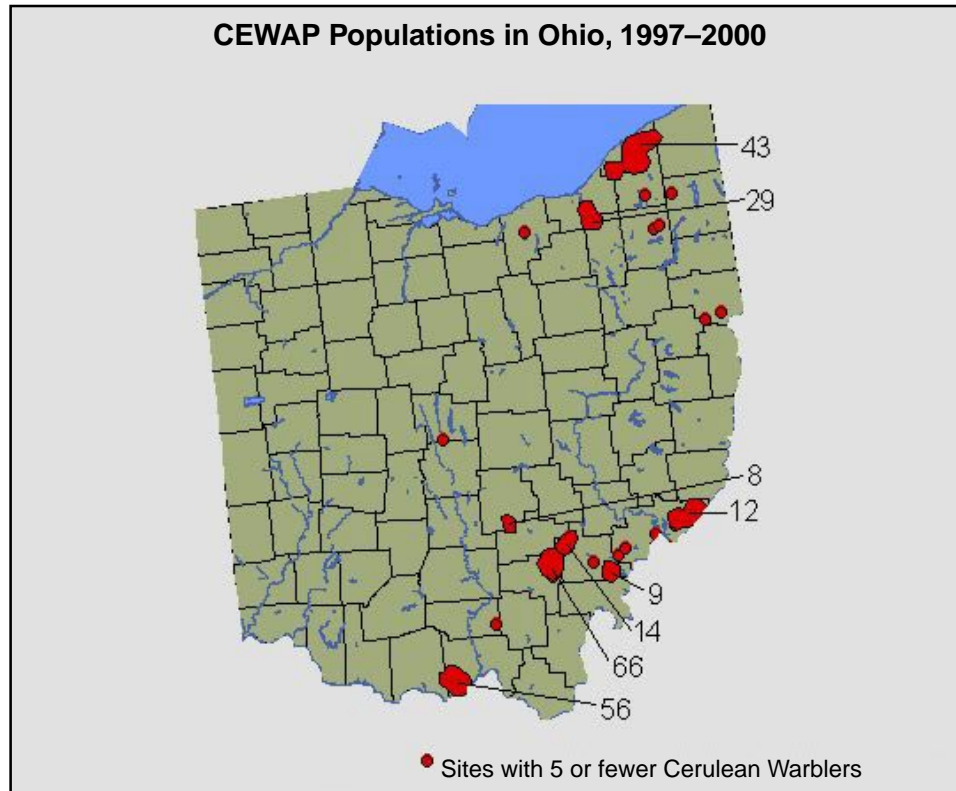
Figure 25. Predominant tree species reported at occupied sites in North Carolina. “N” equals number of sites with tree species reported by CEWAP participants.

Ohio

Hamel (2000) reports the following breeding bird atlas information for Ohio: “Peterjohn and Rice (1991) relate the occurrence and abundance of cerulean warblers in Ohio to the occurrence and abundance of hardwood forests. The birds occurred on 51% of priority blocks statewide. They were very frequent in physiographic areas of the state with relatively large amounts

of forest, e.g. 67-89% of blocks in the different portions of the Allegheny Plateau. In the heavily farmed Till and Lake Plain regions, they were encountered in only 21-24% of blocks.” CEWAP surveys were concentrated mainly in the northeast and southeast portions of the state.

CEWAP surveys produced 264 Ceruleans at 62 (79%) of 78 sites visited (Map 24). Two of the most important



Map 24. Cerulean Warbler populations in Ohio. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 15. Important areas for breeding Cerulean Warblers in Ohio.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
56	Shawnee State Park and Forest	Scioto	Dry slope, riparian	750–1100
45	Lake Metroparks	Lake	Riparian, dry slope	650–1160
34	Zaleski State Forest/ Lake Hope St. Park	Vinton	Mesic slope, dry slope	??
32	Hewett Fork, Waterloo Township	Athens, Vinton	Dry slope, mesic slope	???
29	Cuyahoga Valley Nat. Recreation Area— Brecksville Reservation— Cleveland Metroparks	Cuyahoga, Summit	Riparian, dry slope	630-650
14	Utah Ridge, Wayne National Forest— Hocking River	Athens	Mesic slope, riparian	??
12	Wayne National Forest—Ludlow, Independence, Lawrence Township	Washington	Dry slope, mesic slope	660–1200
8	Clear Creek Valley	Hocking/Fairfield	Riparian	??
7	Marie J. Desonier State Nature Preserve	Athens	Riparian	??

areas were at opposite ends of the state — the Shawnee State Park and Forest in Scioto County, with 56 birds, and Lake Metroparks in Lake County with 45 birds (Table 15). Numerous other areas in the state also supported moderate numbers of Ceruleans, with a cluster of sites around the Zaleski State Forest in Vinton and Athens Counties supporting 66 birds and several sections of Wayne National Forest reporting at least 26 individuals.

Of 62 sites with known habitat conditions, 27 (43%) were classified as riparian/swamp forest, while 18 (29%)

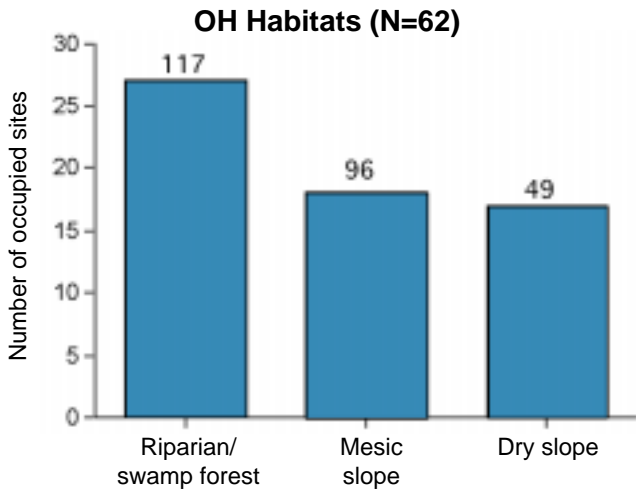


Figure 26. Habitat classifications at sites with Cerulean Warblers in Ohio. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

and 17 (27%) were classified as mesic slope and dry slope, respectively (Figure 26).

For 55 sites reporting tree species data, the most common species included oaks, maples, and sycamore (Figure 27). Dry slope habitats in southern Ohio were dominated by chestnut oak, scarlet oak, white oak, and hickories, whereas more mesic upland sites had predominantly white oak, maples, some American beech, and some tulip tree. Riparian sites in northeast Ohio were primarily sycamore forests with some cottonwood, tulip tree, walnut, and maples.

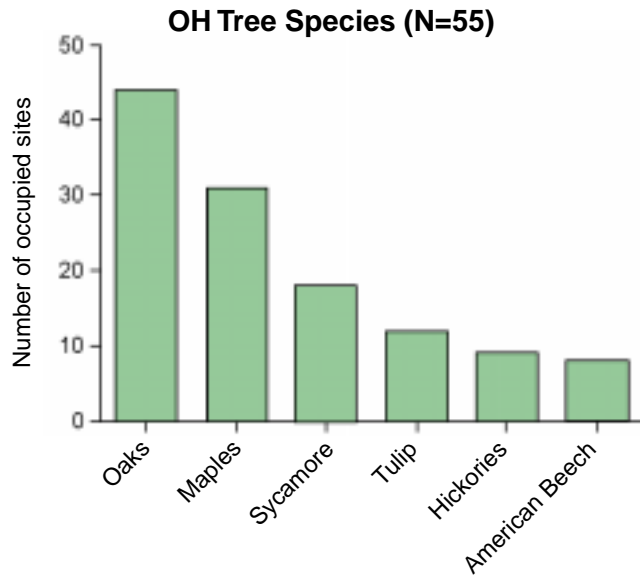


Figure 27. Predominant tree species reported at occupied sites in Ohio. “N” equals number of sites with tree species reported by CEWAP participants.

Pennsylvania

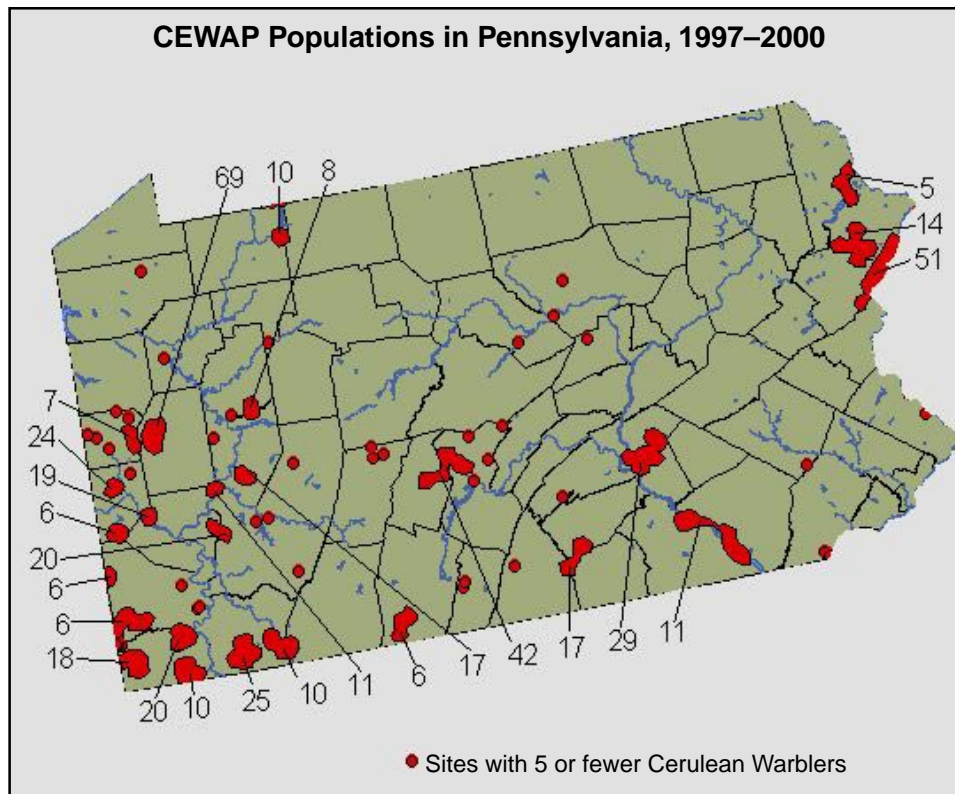
The *Atlas of Breeding Birds in Pennsylvania* (Brauning 1992) reported Cerulean Warblers from 836 (17%) atlas blocks statewide. Ceruleans were reported from nearly every county in the state; however, they were most frequently observed in the southwest corner (Pittsburgh Plateau). CEWAP surveys were focused mainly in the south-central and southwestern portions of the state, with additional coverage along the Delaware River Valley in northeast Pennsylvania.

CEWAP surveys tallied 548 Cerulean Warblers at 182 (89%) of 206 sites visited (Map 25). No single site within the state produced a large number of observations; however, several sites supported more than 25 Ceruleans. These included the Juniata River Valley in Huntington and Blair counties, Delaware River Valley in Pike and Monroe counties, Moraine State Park and Jennings Environmental Center in Butler county, and Peter’s Mountain State Game Lands in Dauphin County (Table 16). Roughly half of the Ceruleans found were in the Ohio

Hills physiographic area of southwestern PA, another 30% were in the Ridge and Valley, and the remainder were scattered through the Allegheny Plateau and Piedmont regions. The Delaware River and adjacent highland population is contiguous with a large population in northwestern New Jersey, and the small population at Allegheny Reservoir is also probably much larger and contiguous with the Allegheny State Park area population in New York. In extreme southeastern Pennsylvania, the small population along White Clay Creek is contiguous with a similar number of birds found in adjacent Delaware. Undoubtedly many more Cerulean Warblers occur throughout Pennsylvania, in areas not searched during CEWAP.

Habitat data were reported for 178 of the Pennsylvania sites. Sixty-eight sites (38%) and 178 individual Cerulean Warblers (33%) were in riparian or other bottomland habitats (Figure 28), with an additional 155 birds (28%) at 57 dry slope or ridgetop sites.

(Continued on page 41)



Map 25. Cerulean Warbler populations in Pennsylvania. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 16. Important areas for breeding Cerulean Warblers in Pennsylvania.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
42	Juniata River and vicinity	Huntington, Blair	Riparian	740–830
40	Delaware River Valley	Pike, Monroe	Riparian, upland	335–990
37	Moraine State Park	Butler	Dry slope, lake margin	1200–1550
32	Jennings Environmental Center	Butler	Dry slope	1220
29	Peter’s Mountain and State Game Lands	Dauphin	Dry slope, lake margin	700–1320
23	Brady’s Run County Park	Beaver	Dry slope	1000
22	Forbe’s State Forest and vicinity	Fayette	Dry slope	1500–2700
20	Duff Park and Boyce Park	Westmoreland	Dry slope, riparian	940–1360
20	Ten Mile Creek and vicinity	NE Greene	Riparian, dry slope	820–1000
19	Sewickley Heights Park	Allegheny	??	900
18	Ryerson Station State Park and vicinity	W Greene	Riparian, upland	1000–1200
17	Michaux State Forest	Adams, Cumberland	Dry slope	1475
15	Crooked Creek Lake Park, Cochran’s Mills	Armstrong	Dry slope, riparian	840
14	Delaware State Forest areas	Pike, Monroe	Dry slope	1800–2000
11	Lower Susquehanna River	York	Riparian	225–325
11	Harrison Hills Park	Allegheny	Dry slope	??
10	Ohiopyle State Park and vicinity	Fayette	Dry slope, mesic slope	1950–2135
10	Kinzua Bay, Allegheny Reservoir	Warren, McKean	Dry slope	500
10	Perry, Dunkard Townships	SE Greene	Riparian	1000–1100

The most commonly reported tree species at 172 occupied sites included oaks, maples, and sycamore (Figure 29). Riparian sites throughout the state were dominated by sycamores, with black cherry, black locust, tulip tree, white ash, and maples frequently reported. Dry

upland sites reported white oak, red oak, black cherry, and maples as the most frequent trees, whereas various combinations of maples, oaks, tulip tree, and cherry predominated at mesic upland sites.

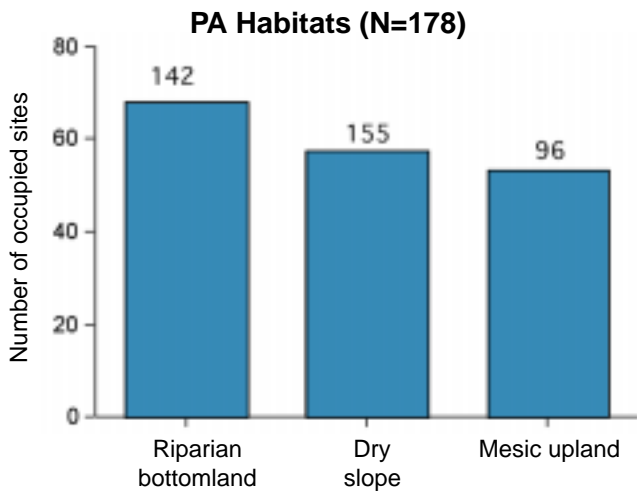


Figure 28. Habitat classifications at sites with Cerulean Warblers in Pennsylvania. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

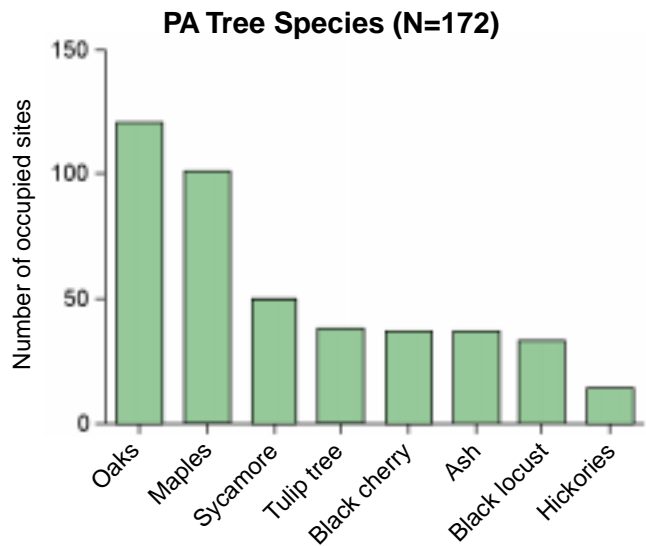


Figure 29. Predominant tree species reported at occupied sites in Pennsylvania. “N” equals number of sites with tree species reported by CEWAP participants.

Rhode Island

No birds observed.

South Dakota

CEWAP participants observed 3 ceruleans at two locations in South Dakota. Two birds were noted at Newton Hills State Park in Lincoln County and 1 bird was observed at Wuabay National Wildlife Refuge in Day

County. The Newton Hills Park birds were in 100-ft. canopy riparian forest dominated by cottonwood, silver maple, elm, and ash, whereas the Wuabay NWR bird was in swamp forest of oaks, basswood, and elm.

Tennessee

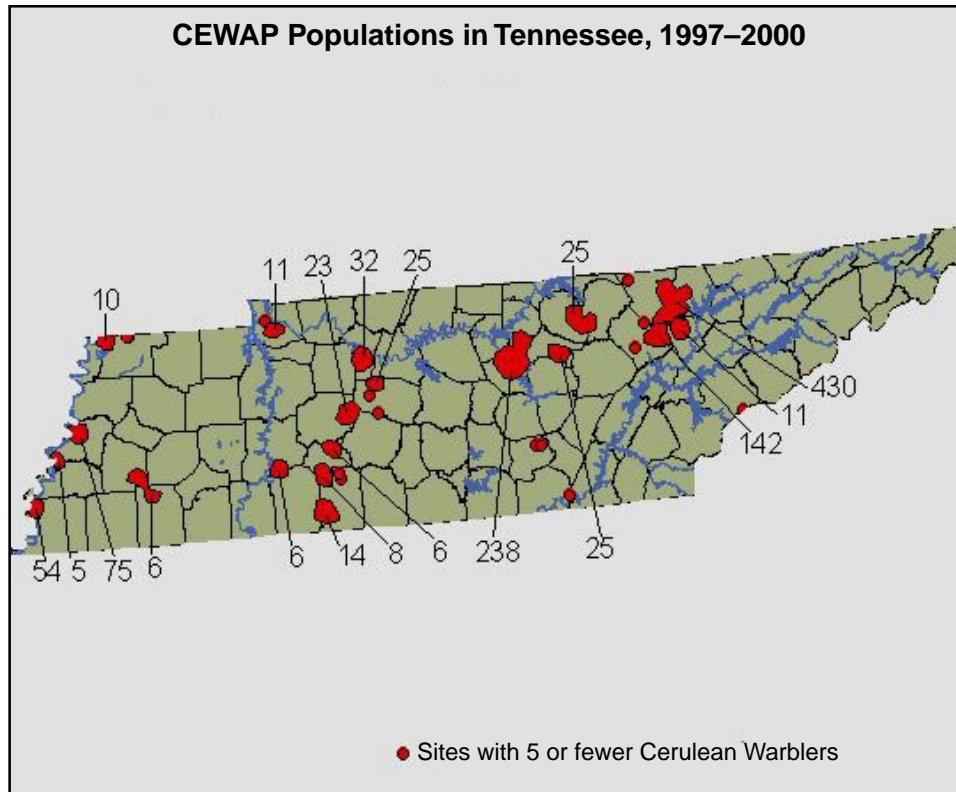
The *Atlas of Breeding Birds of Tennessee* (Nicholson 1997) reported Cerulean Warblers from 14% of “priority atlas blocks” statewide. Much of our data from Tennessee was provided by Melinda Welton of The Nature Conservancy who coordinated intensive surveys of several portions of the state. CEWAP surveys yielded 1,210 birds at 485 sites (Map 26).

By far the most important region in the state for Ceruleans is the Cumberland Mountains of Campbell, Scott, and Morgan Counties, northwest of Knoxville. In particular, the Royal Blue Wildlife Management Area (42,000 ac) supports at least 430 birds and Frozen Head State Park (8,000 ac) and vicinity supports at least 142 birds (Table 17); these represent the only two areas of publicly owned lands within this large mountainous region. Undoubtedly, many more Ceruleans occur on private lands not surveyed. Birds in this area were found

in mesic upland forest dominated by oaks, hickories, and tulip poplar, mostly between 2,000 ft. and 3,000 ft. elevations.

Another very important area is the Center Hill Lake region of DeKalb and Putnam Counties in central Tennessee. In this area, most Ceruleans were found along the more-forested northern shore and surrounding hills, including Edgar Evins State Park, Floating Mill, and Mine Lick Creek. A significant but unknown proportion of these birds were on public recreation area land owned by the Army Corps of Engineers. In summer 2000, an additional 34 birds were located on the escarpment further north in Putnam County. These latter individuals were in relatively young forest, where taller tulip poplars formed an uneven emergent canopy (Welton, pers. comm.).

(Continued on page 42)



Map 26. Cerulean Warbler populations in Tennessee. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 17. Important areas for breeding Cerulean Warblers in Tennessee.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
430	Royal Blue Wildlife Management Area and vicinity	Campbell, Scott	Mesic slope	2000
142	Frozen Head State Park and vicinity	Morgan, Scott	Mesic slope	2100–3200
238	Center Hill Lake, Edgar Evins State Park and vicinity	DeKalb, Putnam	Mesic slope, dry slope	800–900
75	Chickasaw National Wildlife Refuge	Lauderdale	Riparian, swamp forest	240–250
54	Meeman-Shelby Forest State Park, Mississippi Delta	Shelby	Upland, bottomland	240–300
32	Cheatham Wildlife Management Area	Cheatham	Dry slope, mesic slope	500–725
28	Natchez Trace Parkway, National Park	Williamson	Dry slope, mesic slope	865–900
25	Mill Creek Rd.	Putnam	Dry slope	1100–1350
15	Reelfoot National Wildlife Refuge	Hayward, Obion	Bottomland	290
12	Bear Knob	Overton	Dry slope	1360
11	Westvaco Timberlands	Stewart	Dry slope, mesic slope	475–600

A third important region of the state for Cerulean Warblers is along the Mississippi River, where relatively large numbers were found at Chickasaw National Wildlife Refuge (75 birds) and Meeman-Shelby Forest State Park north of Memphis (54 birds). Birds at Chickasaw NWR occupied bottomland hardwood forest dominated by cottonwoods. Additional individuals were found on bluffs along the Mississippi River at Fort Pillow State Park.

Overall in Tennessee, nearly 400 of the 467 sites with reported habitat conditions were classified as mesic slope (Figure 30). These 400 sites accounted for 65% of Cerulean observations, whereas dry slopes supported 20% and riparian/bottomland habitats accounted for the remaining 13%.

For 87 sites where tree species data were reported, the most frequently observed species included oaks (mostly white oak and scarlet oak), hickories, and tulip poplar (Figure 31). Bottomland hardwood sites were dominated by cottonwood, American sycamore, and tulip-poplar.

The Cerulean Warbler population in the Northern Cumberland Plateau region of Tennessee represents the single largest concentration of this species reported from anywhere within its range (see Table 1). Even though many of these birds are on state-owned land, Melinda Welton reports potential threats from surface mining in this area. Royal Blue is a 42,000 acre Wildlife Management Area owned and managed by the Tennessee Wildlife Resources Agency. Tennessee Valley Authority (TVA), however, owns the surface mineral rights to this land and is currently exercising those rights. A mining permit was issued in September 1999 that would directly impact 600 acres. A 100 acre clearcut in preparation for mining was completed in September 2000. Discussions with TVA are currently underway concerning the advisability of proceeding with this mining permit and future permits on Royal Blue. The future of Cerulean Warblers on vast acreages of private land, such as large areas owned by Champion-International, are even more uncertain.

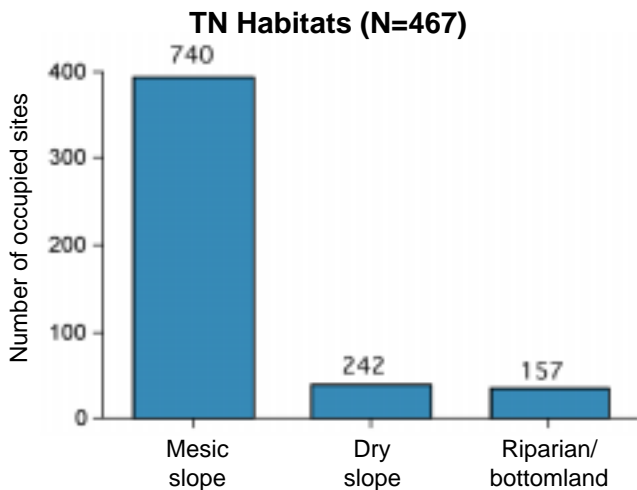


Figure 30. Habitat classifications at sites with Cerulean Warblers in Tennessee. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

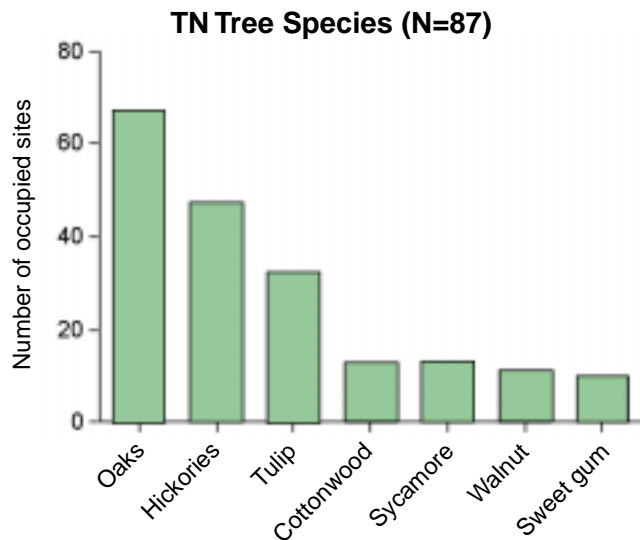


Figure 31. Predominant tree species reported at occupied sites in Tennessee. “N” equals number of sites with tree species reported by CEWAP participants.

Virginia

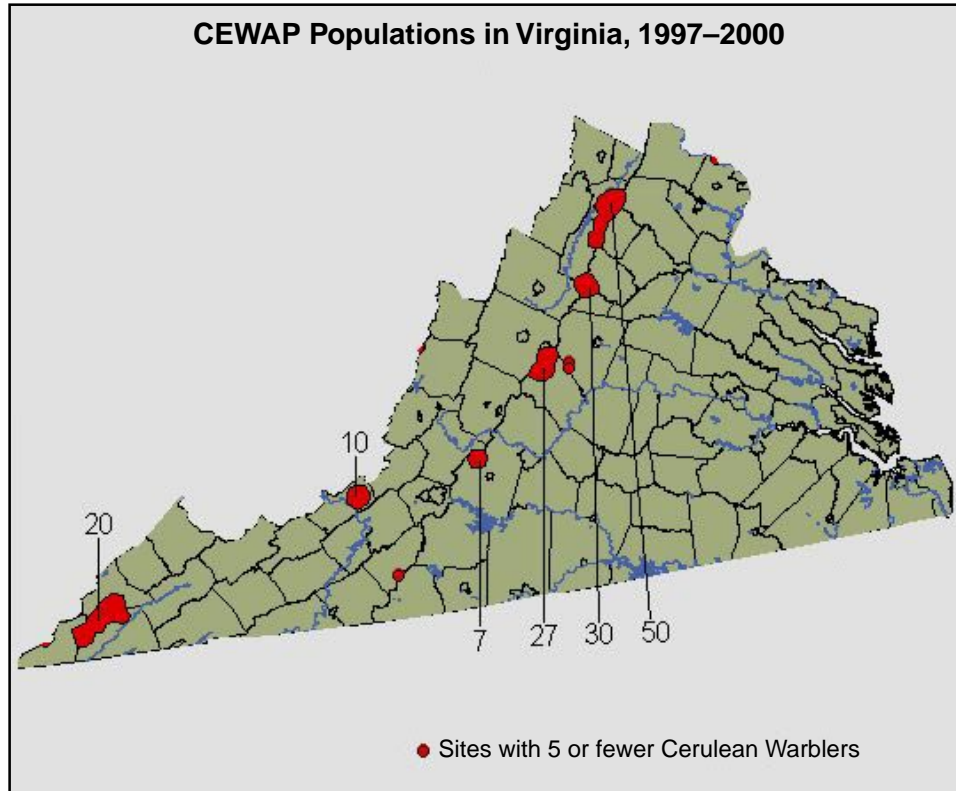
The Virginia Breeding Bird Atlas Project recorded Cerulean Warblers on 88 blocks primarily in the western and northern mountains, and Shenandoah Valley.

CEWAP participants documented 152 birds on 64 (61%) of 106 sites visited (Map 27). A majority of birds found were clustered in three portions of the Blue Ridge — the Pocosin Cabin area of Shenandoah National Park with 30 Ceruleans, the Reeds Gap-Humpback Mountain area with 27 birds, and the north section of

Shenandoah National Park and Appalachian Trail north of U.S. Highway 522 with a total of 44 Ceruleans detected (Table 18). An additional 20 Ceruleans are estimated to occur on the Clinch Ranger District of Jefferson National Forest in extreme western Virginia. Undoubtedly many more Cerulean Warblers occur in unsurveyed portions of the Northern Cumberland Plateau and on the Ridges west of Shenandoah Valley.

For 60 sites with reported habitat conditions, 41 (68%) were classified as mesic cove forest and 18 (30%) dry slope. Mesic cove forests supported 67 (46%) Ceruleans while dry slope forests supported 78 (53%) (Figure 32). The only birds found away from the mountain ridges were two individuals at Riverbend Park on the Potomac River, in cottonwood-silver maple-boxelder forest.

For 61 sites where tree species data were reported, the most commonly recorded species were oaks (mostly northern red oak, chestnut oak and white oak), maples (mostly red maple), and hickories (shagbark and mountain hickory), with tulip tree, white ash, and black locust also frequently reported (Figure 33).



Map 27. Cerulean Warbler populations in Virginia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 18. Important areas for breeding Cerulean Warblers in Virginia.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
30	Shenendoah National Park—Pocosin Cabin Area	Greene	Dry slope	2700–3200
29	Appalachian Trail, N. of US Highway 522	Warren	Mesic cove forest	1200–2000
27	Blue Ridge Parkway—Reeds Gap, Humpback Mtn. Area	Augusta, Nelson	Dry slope	2332–3600
20	Clinch Ranger District, Jefferson National Forest	Lee, Scott, Wise	Dry slope, cove forest	2420–3370
15	Shenendoah National Park—north section	Warren, Rappahannock	Dry slope, cove forest	1950–2800
10	Doe Creek area—Rt. 613	Giles	Dry slope	3100–3400
7	Blue Ridge Parkway, Flat Top Mountain (Jefferson NF)	Bedford	Mesic cove forest	2610–2700
2	Riverbend Park	Fairfax	Riparian	160

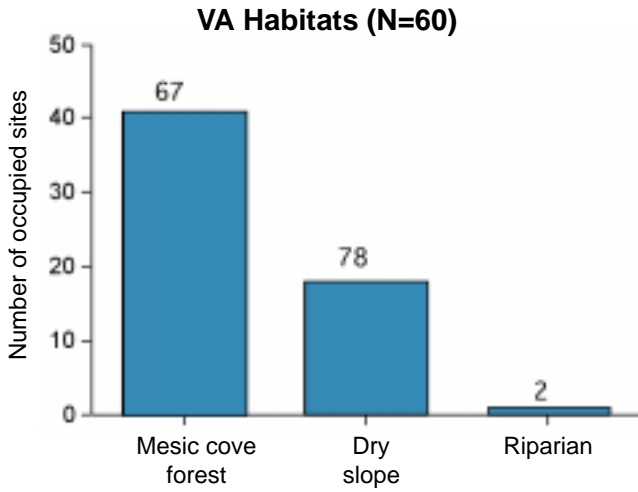


Figure 32. Habitat classifications at sites with Cerulean Warblers in Virginia. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants

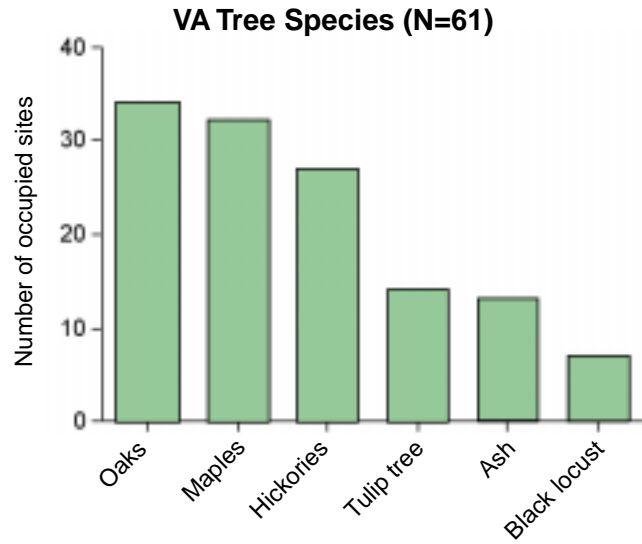


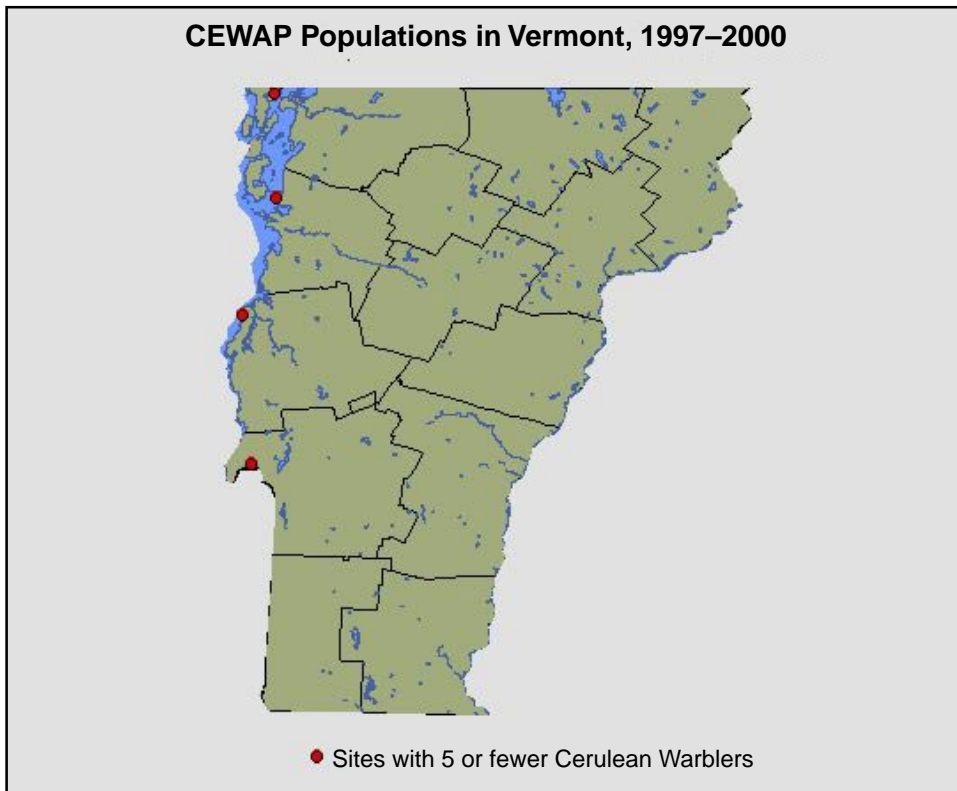
Figure 33. Predominant tree species reported at occupied sites in Virginia. “N” equals number of sites with tree species reported by CEWAP participants.

Vermont

The *Atlas of Breeding Birds of Vermont* (Ellison 1985) reported Ceruleans from only two atlas blocks statewide.

CEWAP participants observed only 1 individual on 1 of 3 sites visited in 1997 and 1998. The bird was observed along the Lamoille River near the town of Milton in Chittenden County. In summer 2000, however, the

previously vacant site near the Quebec border had a singing Cerulean Warbler, and a third location was obtained via Chris Rimmer through the Vermont birding listserv. All known sites in the state are along the east shore of Lake Champlain (Map 28).



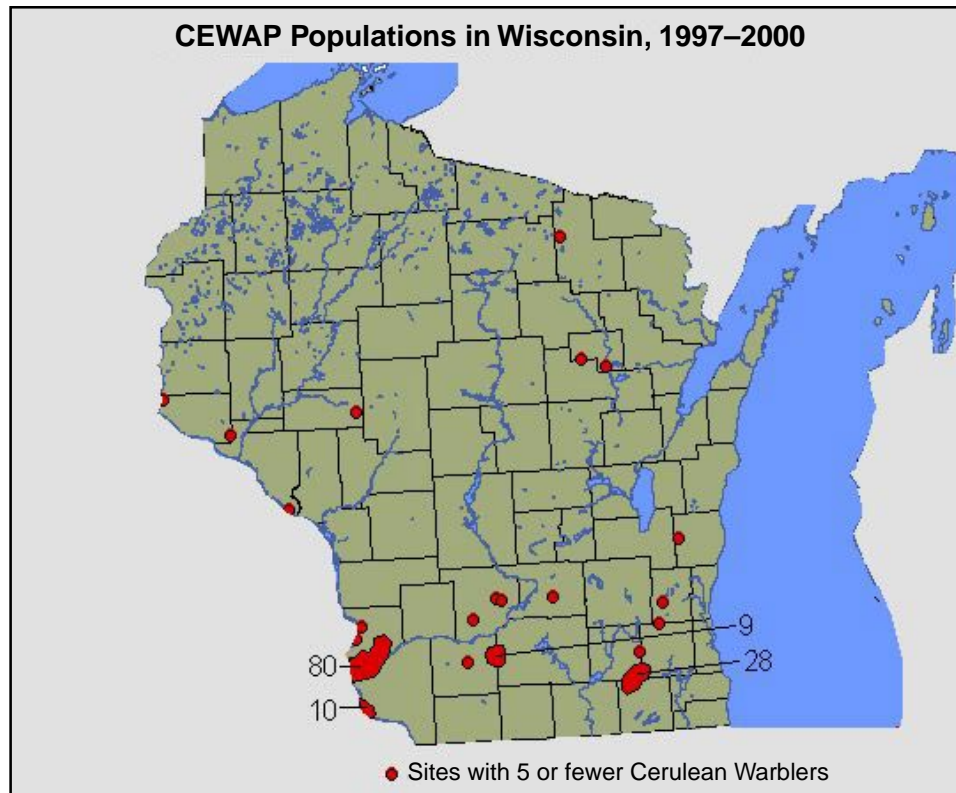
Map 28. Cerulean Warbler populations in Vermont. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Wisconsin

Hamel 2000 reports the following regarding the Wisconsin Breeding Bird Atlas: “Breeding Cerulean Warblers recorded as confirmed, probable, or possible in 3.8% of 3,084 blocks (5 km x 5 km each) surveyed throughout the state, with most birds being found in the southern half of the state in upland hardwood oak-hickory or maple-beech-birch forests (Jennifer Davis,

15 March 2000, pers. comm. to Stephen Lewis).” CEWAP surveys were concentrated in the southern one-third of the state, however, Ceruleans were also noted in the west-central and northeast portions of the state.

CEWAP participants tallied 174 Ceruleans at 59 (98%) of 60 sites surveyed (Map 29). Three sites supported more than 20 birds each—the Lower Wisconsin



Map 29. Cerulean Warbler populations in Wisconsin. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 19. Important areas for breeding Cerulean Warblers in Wisconsin.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
31	Lower Wisconsin River	Grant	Riparian, mesic slope	620-740
24	Wyalusing State Park	Grant	Dry slope, mesic slope	650-1150
20	Lake LaGrange	Walworth	Mesic slope	885-1000
16	Lower Kickapoo River Valley	Crawford	Riparian, mesic slope	690-900
8	Kettle Moraine State Forest	Jefferson	Dry slope	880-890
8	Nelson Dewey State Park	Grant	Riparian	900
6	Blue Mounds State Park and vicinity	Iowa, Dane	Mesic slope	1100-1400
5	Plum Creek	Pierce	Mesic slope	840-900
4	Kinnickinnic State Park	Pierce	Bottomland	900
4	Goat Ranch Rd.	Eau Claire	Mesic forest	1000

River and Wyalusing State Park in Grant County, and Lake LaGrange in Walworth County (Table 19). Sixteen additional birds were found in the Lower Kickapoo River area, just to the north of the Wisconsin River.

Of 56 sites with reported habitat conditions, over half were classified as mesic upland forest, which accounted for 104 (56%) of the Ceruleans observed (Figure 34).

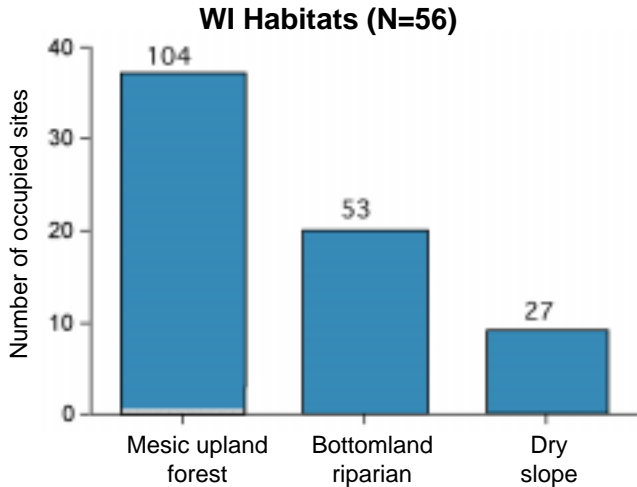


Figure 34. Habitat classifications at sites with Cerulean Warblers in Wisconsin. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

The 20 bottomland riparian sites supported 53 (31%) birds.

For 56 sites with known tree species, the most common trees were oaks, maples, and hickories (Figure 35). Black Walnut and basswood also were frequently reported, and bottomland riparian sites often had cottonwoods and elms.

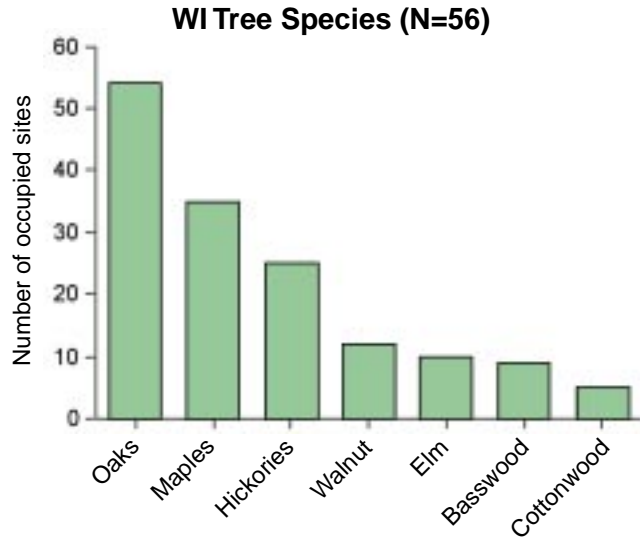


Figure 35. Predominant tree species reported at occupied sites in Wisconsin. “N” equals number of sites with tree species reported by CEWAP participants.

West Virginia

Hamel (2000) reports the following for West Virginia: “Atlas work shows the birds to be widespread and common in the Western Hills, scarce or missing in the Allegheny Mountains Region, and to occur sparingly the Ridge and Valley Region. In the Ridge and Valley Region of West Virginia, the birds are limited to river valleys. Birds were recorded on 258 blocks in West Virginia (Buckelew and Hall 1994).”

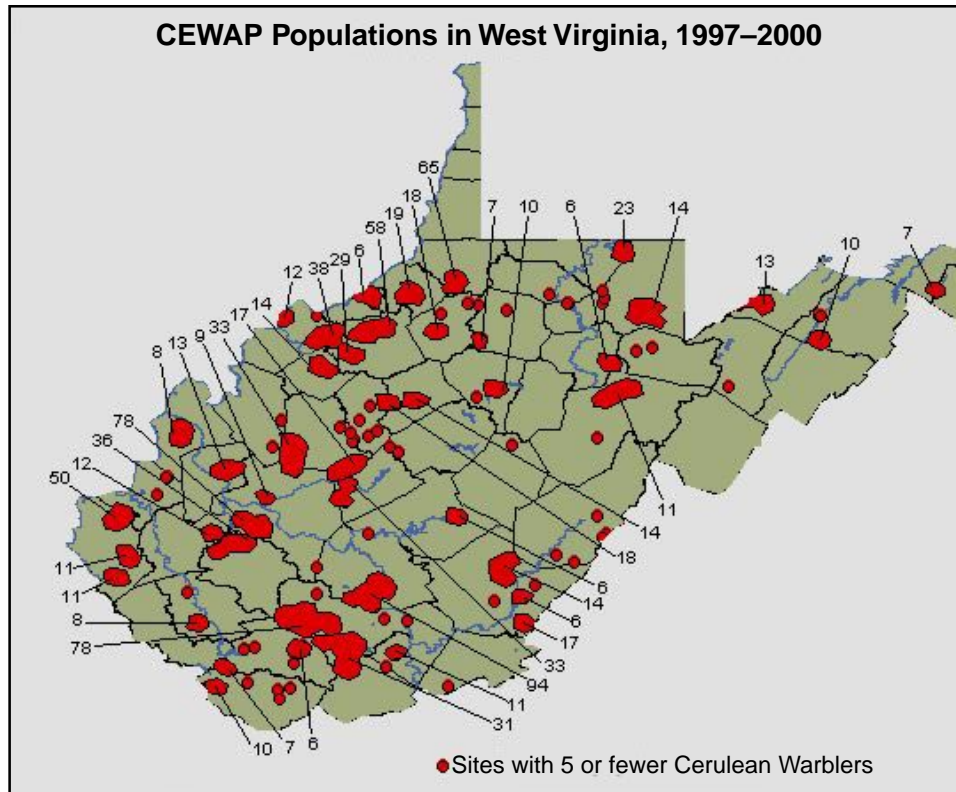
CEWAP coverage was extensive in West Virginia with sites located in most counties (Map 30). A particular effort was made to survey state-owned parks and wildlife management areas, under the supervision of Drew Jones at the West Virginia Department of Natural Resources. Even so, vast areas went unsearched, and total Cerulean Warbler populations are very difficult to determine.

In West Virginia, 1,124 ceruleans were reported from 254 (74%) of 345 sites surveyed during CEWAP. Numerous sites supported more than 20 birds, with the most populated sites being the New River Gorge and Garden Ground Mountain area with 94 Ceruleans found, Kanawha State Forest with 78 birds, Guyandotte Mountain and vicinity with 78 birds, and Louis Wetzel Wildlife Management Area with 65 birds (Table 20). Cerulean Warblers were most widely distributed through-

out the Ohio Hills physiographic area, with smaller populations scattered through the Ridge and Valley. They were rarely found in the large forested regions of the Allegheny Mountains, such as on the Monongahela National Forest. Coverage was poor in the Cumberland Plateau region (no sites surveyed in Mingo County) and in the Panhandle region.

A significant portion of the Ceruleans found in West Virginia were on the many state-owned lands that were surveyed. In all 28 tracts of state land supported 456 singing male Ceruleans. Although this may be a small fraction of the total state population, it may represent a reasonable estimate of the number of birds under potential management or protection by the state of West Virginia. Besides the Kanawha State Forest and Louis Wetzel WMA, important state lands include Beech Fork State Park (50 pairs), Cooper Rock State Forest (23 pairs), and Ritchie Mines WMA (22 pairs).

More than half of the sites reporting habitat data were classified as dry slope/ridgetop (Figure 36). The dry slope/ridgetop sites accounted for 700 (65%) cerulean sightings. The remaining 35% of sites were nearly equally divided between moist slope/cove habitats and bottomland/riparian habitats.



Map 30. *Cerulean Warbler* populations in West Virginia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

The primary tree species noted on 221 occupied sites statewide were oaks, maples, hickories, and tulip tree (Figure 37). Forests with *Cerulean Warblers* were extremely diverse. At riparian sites, sycamores were dominant, with cottonwoods, white oak, red oak, various maples, boxelder, tulip tree, and black locust also frequently reported. Dry slopes and ridgetops were dominated by white oak, red oak, scarlet oak, chestnut oak, shagbark, mountain, and pignut hickories, and red maple, whereas mesic slopes and cove forests were

dominated by white oak, red oak, sugar maple, tulip tree, with American beech, basswood, and black cherry also common (Figure 37).

In West Virginia, our field assistants also collected detailed data on tree-species use by foraging or singing *Cerulean Warblers* in 1997. Observations of foraging and singing birds at upland sites (N = 150) indicated frequent use (10-17%) of chestnut oak, red oak, maples, hickories, and white oak, with lesser use of tulip tree, black oak, and 11 other tree species (Figure 38).

Table 20. Important areas for breeding *Cerulean Warblers* in West Virginia.

<i>Number of birds</i>	<i>Site location</i>	<i>County (s)</i>	<i>Habitat (s)</i>	<i>Elevation (ft)</i>
94	New River Gorge— Garden Ground Mountain Area	Fayette, Raleigh	Dry slope, riparian	1330–3000
78	Kanawha State Forest	Kanawha	Mesic cove forest, dry slope, riparian	800–1500
78	Guyandotte Mountain and vicinity	Raleigh, Boone, Wyoming	Upland forest	2500–3230
65	Louis Wetzel WMA	Wetzel	Dry slope, riparian	823–1500
50	Beech Fork State Park	Wayne	Lake margin, dry slope	625–940
50	North Bend State Park and Rail Trail, Mountwood Park	Ritchie, Wood	Dry slope, cove forest, riparian	700–1110
40	Greenbrier River drainage and adjacent mountains	Greenbrier	Dry slopes	2100–3500
36	Fork Creek WMA— Little Coal River and vicinity	Boone, Lincoln, Kanawha	Riparian, mesic slope	875–1130
28	Murphy Preserve	Ritchie	Moist cove forest, dry slope, riparian	900–1085
23	Coopers Rock State Forest	Preston, Monongalia	Mesic slope, dry ridgetop	2060–2280
22	Ritchie Mines WMA	Ritchie	Dry slope	1000–1120
19	Dutch Ridge	Klanawha, Clay	Dry slope	1150
18	Stuption WMA	Calhoun, Gilmer	Dry slope	900–1000
18	Maxwell Ridge	Doddridge	Dry slope	1250
17	Wallback WMA	Kanawha	Riparian, dry slope	640–1100
16	Sand Hill WMA	Wood, Ritchie	Dry slope, mesic slope	1100–1300
14	Rowlesburg	Tunnelton	Dry slope, bottomland	1525–2100
14	Cedar Creek State Park	Gilmer	Dry slope	750–1225
13	Amherst—Plymouth WMA	Putnam	Riparian, mesic slope, dry ridgetop	560–1000
13	Rowlesburg—Laurel Mountain	Preston	Dry slope, bottomland	1440–2100
12	Mud River	Boone	Riparian, moist cove forest	750
11	McDonough	Wood	Dry slope, mesic slope	700–820
11	Bluestone State Park	Summers	Riparian	2200
10	Panther State Forest	McDowell	Upland forest	??
10	Nathaniel Mountain	Hampshire	Dry slope	2600–3000

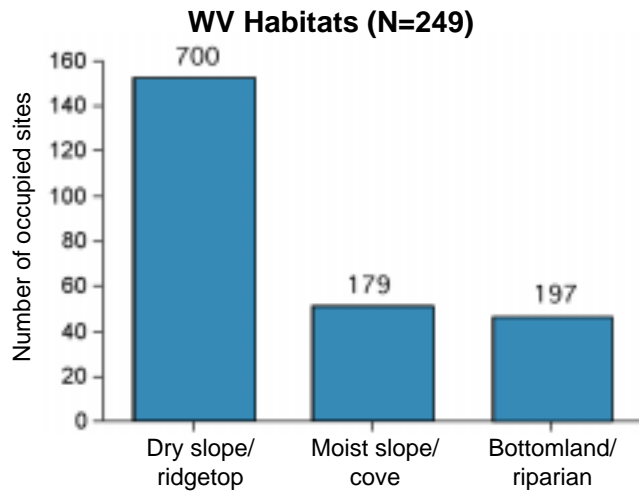


Figure 36. Habitat classifications at sites with Cerulean Warblers in West Virginia. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. “N” equals number of occupied sites with habitat data reported by CEWAP participants.

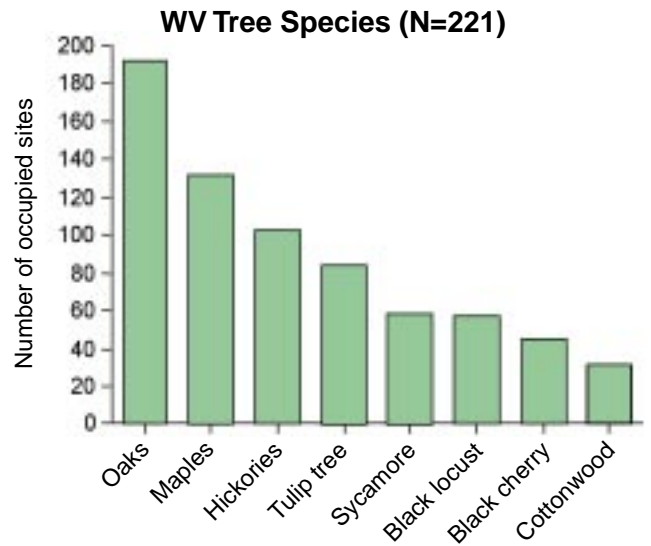


Figure 37. Predominant tree species reported at occupied sites in West Virginia. “N” equals number of sites with tree species reported by CEWAP participants.

Tree Species Use (West Virginia—N=150)

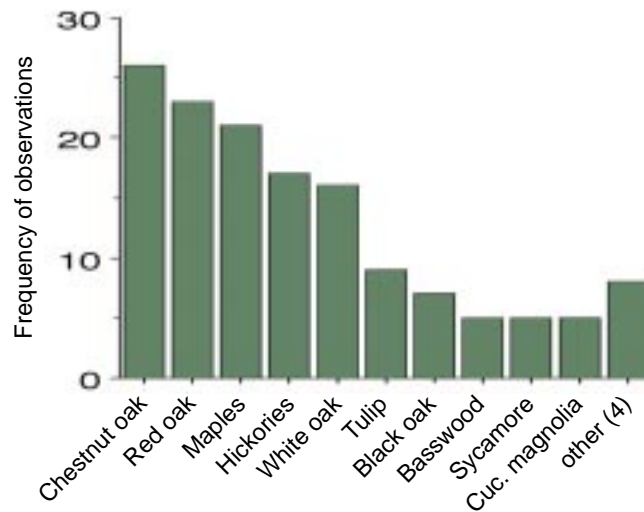


Figure 38. Trees species used by Cerulean Warblers for foraging and singing at upland sites in West Virginia.

DISCUSSION AND CONCLUSIONS

The Cerulean Warbler Atlas Project produced a list of several hundred sites that are important to this species in every state throughout its range. Although these represent a critical first step in conserving key populations of Cerulean Warblers in each region, coverage and completeness of the atlas surveys was highly variable in different parts of the species' range. In general, coverage near the edge of the Cerulean's range was probably most complete and accurate. For example, it is likely that most of the existing populations and sites were identified in New England, New Jersey, most of New York, Illinois, Alabama, Georgia, and Minnesota. In contrast, sites identified in West Virginia, Pennsylvania, Ohio, Kentucky, and much of Tennessee most likely represent only a small fraction of the populations that actually exist in these states. It is extremely difficult for us to assess the completeness of CEWAP in most states without much further fieldwork and consultation with local experts.

To compare with numbers of birds found by CEWAP participants, very crude estimates of Cerulean Warbler total populations can be calculated from Breeding Bird Survey relative abundances in each physiographic area. The BBS may provide landscape-level density estimates that can be converted into regional population estimates if the following assumptions are made:

1. BBS routes constitute a random sample of the landscape;
2. habitats in question are fairly evenly distributed across the region; and
3. each bird species has a relatively fixed average detection distance at BBS stops, within which a reasonable estimate of the number of individuals present may be obtained.

An entire BBS route composed of 50 stops, each consisting of a 0.25 mi. (400 m)-radius circular count, potentially surveys roughly 25 km² of heterogeneous landscape. Based on a study by Emlen and DeJong (1981), we may estimate the average maximum detection distance for typical forest birds to be roughly 125 m—for these species a BBS route samples an effective area of 2.5 km². If Cerulean Warblers are detected routinely out to 200 m at each stop, the effective area surveyed is increased to 6.3 km².

Population estimates for a physiographic area are then calculated as the average landscape-level density (number of birds per route * effective area sampled by each route) multiplied by the size (km²) of the physiographic area. Note that landscape-level densities are not assumed to be similar to species densities in uniform optimum habitats, but rather reflect habitat heterogeneity at larger scales as sampled by BBS routes. Because the great majority of detections on typical BBS routes are of singing or displaying males, the population estimate derived from this method is assumed to represent numbers of breeding pairs.

Applying this methodology produces a range of estimates for Cerulean Warblers throughout their range that is usually much larger than that detected by CEWAP (Table 21). In fact a global population estimate of 85,000 to 214,000 breeding pairs would indicate that CEWAP found fewer than 10% of existing birds. As expected, the largest proportion of the total population occurs in the Ohio Hills and Northern Cumberland Plateau, where an average of 2 to 3 Cerulean Warblers are detected annually on every BBS route in the last decade. In West Virginia alone, the total population is almost certainly in the 10,000s, and may be close to 100,000 pairs. In physiographic areas near the periphery of the Cerulean's range; however, the number of birds found is not greatly different from that estimated using BBS – for example, Southern New England, Lower Great Lakes Plain.

Our atlas is therefore most valuable in areas away from the center of the species' distribution. Populations and sites identified in most states may serve as the nucleus for a conservation strategy that should include continued monitoring, management, and possible acquisition of currently unprotected sites. In the center of the range, specific sites may also be important for long-term monitoring and to provide a sample of the range of conditions required by this species. Because many sites identified are on public lands, these may also serve as core areas for sustaining regional populations. Where Cerulean Warblers are more continuously distributed and do not lend themselves to a "circles on maps" atlas technique, a modeling approach, taking into account different densities in different habitats, may be necessary to identify the most important areas for sustaining the bulk of the population.

Table 21. *Cerulean Warbler populations size estimates for Partners In Flight physiographic areas, based on extrapolations from BBS relative abundance. Range of estimates based on assumptions of effective area covered by each BBS route between 6.3 km² and 2.5 km²*

<i>Physiographic Area Name</i>	<i>Area #</i>	<i>BBS Population Range (pairs)</i>
South Atlantic Coastal Plain	3	40–100
East Gulf Coastal Plain	4	330–840
Southern New England	9	90–225
Mid-Atlantic Piedmont	10	600–1,500
Mid Atlantic Ridge and Valley	12	2,550–6,400
Southern Ridge and Valley	13	95–240
Interior Low Plateaus	14	7,300–18,500
Lower Great Lakes Plain	15	210–530
Upper Great Lakes Plain	16	360–950
Northern Ridge and Valley	17	2,000–5,200
St. Lawrence Plain	18	150–400
Ozark-Oachita Plateau	19	1,950–4,900
Boreal Hardwood Transition	20	1,850–4,600
Northern Cumberland Plateau	21	22,700–57,200
Ohio Hills	22	37,600–94,700
Southern Blue Ridge	23	1,250–3,100
Allegheny Plateau	24	4,450–11,200
Prairie Peninsula	31	750–1,900
Osage Plains	33	85–210
West Gulf Coastal Plain	42	110–275
Mid Atlantic Coastal Plain	44	25–65

Habitat and Area Requirements

Primary habitat for this species is most often described as mature deciduous forest, typified by structurally mature hardwood species in mesic or floodplain conditions with a closed or semi-open canopy. Habitat descriptions in the literature often have emphasized moist woodlands in both upland and bottomland forest (e.g. Schorger 1927, DeJong 1976) in different regions. Hamel (2000) summarizes the broad range of habitat descriptions that exist for this species, concluding that Cerulean Warblers may be somewhat opportunistic in seeking the most mature forest conditions available in each region. Dominant tree species and understory species described in the literature also tend to vary by region; tree size is thought to be primary and tree species of secondary importance (Hamel 2000).

Habitat data from CEWAP confirm the wide range of habitat types used by Cerulean Warblers throughout their range. Large populations occur in both riparian bottomland forests and in a variety of upland situations. Perhaps under-appreciated in past accounts is the importance of dry slope and ridgetop habitats to Cerulean Warblers, not only in the Appalachian ridges, but also

in New England and the upper Midwest. Although many of these slopes and ridges are in relatively close proximity to major river valleys, suggesting that populations may “spill” up the slopes from the bottomlands, this is not always the case. For example, dry ridges seem to be the primary habitat of this species in many parts of the Blue Ridge of Virginia and North Carolina. The most important feature of this habitat type, perhaps, is the presence of mature oak-hickory forest, with white oak, red oak, black oak, scarlet oak, and chestnut oak frequently mentioned as dominant.

Throughout much of the Southeast and northwards through the Appalachians, a very important habitat for Cerulean Warblers continues to be mesic upland forest, including mixed mesophytic or cove forest. CEWAP confirmed the large populations that occur wherever large tracts of this habitat exist, and also the great diversity of tree species present at these sites. Tulip tree appears to be a common indicator of Cerulean habitat in many of these areas, in addition to the variety of oak species and often maples.

Away from the Appalachian Mountains, a majority of Cerulean Warbler populations seem to occur in mature riparian or other bottomland forests along large or

medium-sized waterways. Only a few pockets of Ceruleans persist in the Mississippi River Valley proper, but a number of tributaries support the bulk of the species in the Midwest Region. Other important riparian areas include the Delaware River Valley, Roanoke River in Virginia, middle Hudson River, and forested wetlands of the Lake Ontario Plain in New York. A common feature of these riparian forests, nearly throughout the range, is the presence of mature stands of sycamores.

Hamel (2000), as well as other authors, have struggled to find a common denominator among the varied descriptions of Cerulean Warbler habitat structure and tree-species use. A tall, but broken, canopy seems to be the most frequently mentioned feature, along with large area requirements. Indeed, a shared feature of the three very different habitat types used by a majority of Cerulean Warblers may be the irregular canopy structure. On dry ridges, tall oaks form a linear “internal edge,” where warbler territories may look out over the surrounding canopy. This same linear canopy edge is a prominent feature of mature riparian forests, especially where tall sycamores form an emergent layer above the other trees. On slopes with a diverse mixed mesophytic forest, the presence of trees with a variety of canopy structures is probably key to providing the same sort of canopy-edge effect desired by Cerulean Warblers. Melinda Welton’s observation of Ceruleans inhabiting secondary forest patches in Tennessee, where tulip trees form a broken emergent canopy, suggests that this tree may be an important structural ingredient in otherwise closed-canopy oak forests.

Landscape situation and context has a strong bearing on whether otherwise suitable breeding habitat will actually contain warblers (Hamel 1992). Cerulean Warblers are thought to prefer large, contiguous tracts of deciduous forests for breeding (Bond 1957, Hamel 1981, Robbins et al. 1992). Hamel (2000) notes the geographic variation and inconsistency of published references to area sensitivity, however. For example, this species seems to prefer large wooded tracts of at least 50-75 acres, and typically avoids isolated woodlots less than 20-25 acres in size in Ohio (Peterjohn and Rice 1991). In other areas, stands greater than 526 ha (1,300 acres) are considered optimal for Cerulean Warblers (Evans and Fischer 1997).

CEWAP results, although providing only crude estimates of habitat-patch sizes occupied by Cerulean Warblers, do suggest geographic variation in degree of area sensitivity. Whereas a large number of individuals occurred in extensive forest tracts in all regions, the pro-

portion of birds in these large patches varied among the regions. In the Southeast, nearly all birds found were in forests $\geq 1,000$ acres, suggesting strong area sensitivity, whereas in the Northeast, a substantial proportion of populations were in much smaller forests. Further defying the conventional wisdom on Cerulean Warblers, a growing body of research in eastern Ontario suggests that birds there thrive in patches of secondary maple forest as small as 25 acres (Jason Jones, pers. comm). Because quantitative studies of area requirements in Cerulean Warbler come primarily from the Mid-Atlantic and southeastern states (Robbins et al. 1989, Hamel 1992), rangewide assumptions of extreme area sensitivity may be exaggerated.

Monitoring and Research Needs

This Atlas of Cerulean Warbler Populations may be considered a first step in identifying the key sites and habitats required to protect this species into the future. For a successful conservation strategy that ensures the maintenance of healthy breeding Cerulean Warbler populations throughout the species’ range, we recommend the following monitoring and research components:

- Repeat surveys of the 73 primary and secondary sites identified in Table 1 and 2, perhaps every five years, to monitor health of known, important populations.
- Quantitative studies of reproductive success and population turnover in upland vs. bottomland habitats, specific to each region.
- Quantitative studies of regional area sensitivity, perhaps using GIS analyses of habitat patches identified in CEWAP.
- Habitat suitability modeling to determine new and potential population sites, especially in areas where CEWAP was less effective.
- Quantitative studies of response to management options, such as canopy thinning, selective logging, or wilderness protection.
- Determination of potential threats to important CEWA populations, such as from mountaintop removal mining, residential development, or logging.
- Determine pattern of land-ownerships at important areas in each region: devise alternative strategies for conservation and management on public, vs industrial, vs private lands.

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APPENDIX

Appendix I. List of CEWAP participants from 1997–2000. The names in bold represent paid field assistants.

Ray Adams	David Davis	Marc Ingramm	Dennis Miranda	Debbie Simpkins
Brian Allen	Tom Davis	Rainy Inman	Donna Mitchell	Dave Sing
Steve Allen	Deana Dawson	Harriet Irwin	Laura Mitchell	Steve Sjogren
Kathleen Anderson	Bara Dean	Venkatesh Iyengar	Nell Moore	Jack Skalicky
Rod Annelin	John DeMary	John Jacobs	Mike Morgante	Sheila Sleggs
Richard Armstrong	Tom Demeo	Doug James	Eugene Morton	Chris Sloan
James Ash	Melissa Dennison	Bob Janssen	Terry Mosher	Venett Shari Smith
Jennifer Akin	Jenny Dickson	Margaret Jewett	Greg Moxhay	Carl Smith
Fred Atwood	Kara Donovan	Mark Johns	James Murphy	Jessica Smith
Timothy Baird	Carol Doscher	Drew Jones	Rod Murray	Marty Smith
Nick Barber	Sam Droege	Jason Jones	Rich Nicholls	Michael Smith
Ken Barmore	Douglas Dwyer	Peter Jones	Chuck Nicholson	Tom Smythe
G. Beaton	Tom Eckert	William Jones	Lisa Nutt	Peary Stafford
Ralph Bell	Jocelyn Eikenburg	Steven Joule	Darrien O'Brien	P. Stanko
John Benzinger	Karen Eldestein	Steve Kelling	Karl Overman	Barbara Stedman
Dan Best	Michael Elsea	Art Kennell	Lydia Page	Rich Stevens
Doug Blatny	Russell Emmons	Terry Kerns	Kristopher Palermo	Dollie Stover
Brad Blodget	Bill Evans	Michael Kielb	Kristopher Palermo	Vori & Joe Strasser
Susan Boettcher	David Ewert	C. Lawrence King	Al Parker	Steve Stucker
Nicholas Bolgiano	Bruce Fall	Tim Kippenberger	Walter Pawloski	Patricia Sulouff
Darcie Bomkamp	Victor Fazio	Nathan Klaus	Lynda Perry	Scott Sutcliffe
W. Brad Bond	Sam Febba	Geo Kloppel	David Peters	Paul Sutera
D. Bonter	John Fedak	David Knapp	Anna Pidgeon	Rob Tallman
Aileen Boyd	Gary Felton	Chris Knoll	Ron Porter	Andrew Taylor
Patrick Boyd	Bob Ford	Ray Korpi	Diane Potter	Maeve Taylor
Dan Brauning	Chip Franke	Yulee Larner	Doug Powless	Roger Tess
Hunter Brawley	Dick Franz	Laurie Larson	Craig Provost	Chris Tessaglia-Hymes
Cindy Breedlove	Carl Freeman	Jack Lash	Bill Purcell	Steve Thomas
Matthew Bribitzer-Stull	Aaron Gabbe	Thomas LeBlanc	Charles Quinlan	William Tolin
Joseph Brin	Natalia Garcia	Roma Lenehan	Grace Randolph	David Trently
Jeff Buecking	Paula Gills	Fred Leshner	Mary Ratliff	Glendy Vanderah
Barbara Butler	Heather Gockley	Josh Lipton	Bill Reddinger	Katrina Van Tassel
Lois Butler	Charolette Goedsche	Robert Long	Jack Reinoehl	Bob Van Wagner
Adam Byrne	Rod Goforth	Jim Lowe	Lanraine Reynolds	Shawchi Vorisek
Ron Canterbury	Michelle Goldsborough	Judy Lund	Jean Richter	Ronald Wagner
Rick Cantu	Jim Granlund	JM Lynch	Matt Ricketts	Allen Waldron
Jacki Carey	Jane Graves	Glenn Lynn	Chris Rimmer	Mindy Walker
Bernie Carr	Mark Greene	Smoot Major	Joseph Robb	Joe Walko
Joan Carr	Ralph Grundell	Michael Marks	Mark Robbins	Ron Weeks
John Cecil	James Grundy	Bill Martinus	Don Roberson	Carol Weiss
Dexter Chafee	Carol Guba	May	Peter Robinson	Alan Wells
Davis Chapman	Tom Hall	Mark McConaughy	Scott Robinson	Jeffrey Wells
Allen Chartier	Paul Hamel	David McConnell	Peter Rodewald	LaRue Wells
Dwight & Ann Chasar	Lise Hanners	Vickie McDonald	Jennifer Rood	Melinda Welton
John Churchill	Nancy Harple	C. McGrath	Stephen Ross	Richard Whiteford
Lathe Clafin	Bob Hartman	Francis McMenemy	Norma Rudesill	Whitmore
Roger Clifford	Larry Hedrick	John McNeely	Ron Runkles	Martin Wilcox
Mary Clinton	Sheldon Henderson	Frances McVay	Maragaret Rusk	Gene Wilhelm
Bruce Cohen	Joey Herron	Doug McWhirter	Bill Sanderson	Ron Wolf
David Corsini	Anthony Hertz	Jerry McWilliams	Steve Santner	Joan Wolfe
Linda Crabtree	Paul Hess	Peter Mehring	William Schieble	Doug Wood
Julie Craves	Michael Hill	Scott Meier	Russ Schipper	Pei-Hsing Wu
Rickie Crone	Ron Hoff	Mike Mencotti	John Schukman	Helen Wuestenfeld
Ginnie Cronenberger	Karen Holmes	Ken & Cassandra	Chris Schumacher	Peter Wulfhorst
John Cruzan	Marjorie Howard	Middleton	Donnette Sellers	Alice Yeaman
Paul Cypher	Amy Howe	Dorothy Miller	Janet Shaffer	Matt Young
Darney	Dainne Huggelt	Kip Miller	Robert Shulz	Yovanovich
Dale Davis	Chuck Hunter	Susan Miller	T. Simons	G. Ziarno